Recent Foraminifera from Shore Sands of Rameswaram, South India

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Aligarh 28.6.82

I certify that the dissertation entitled "RECENT FORAMINIFERA FROM SHORE SANDS OF RAMESWARAM, SOUTH INDIA" is a record of research work done by Mr. S. Qasim Abbas Jafri, M.Sc., in partial fulfilment of M.Phil. degree in Geology, under my supervision. As far as I am aware this material has not been previously used for the award of any degree.

He is allowed to submit the work for the award of M.Phil. degree of the Aligarh Muslim University, Aligarh.

(S.M. RASUL)
Professor and Chairman
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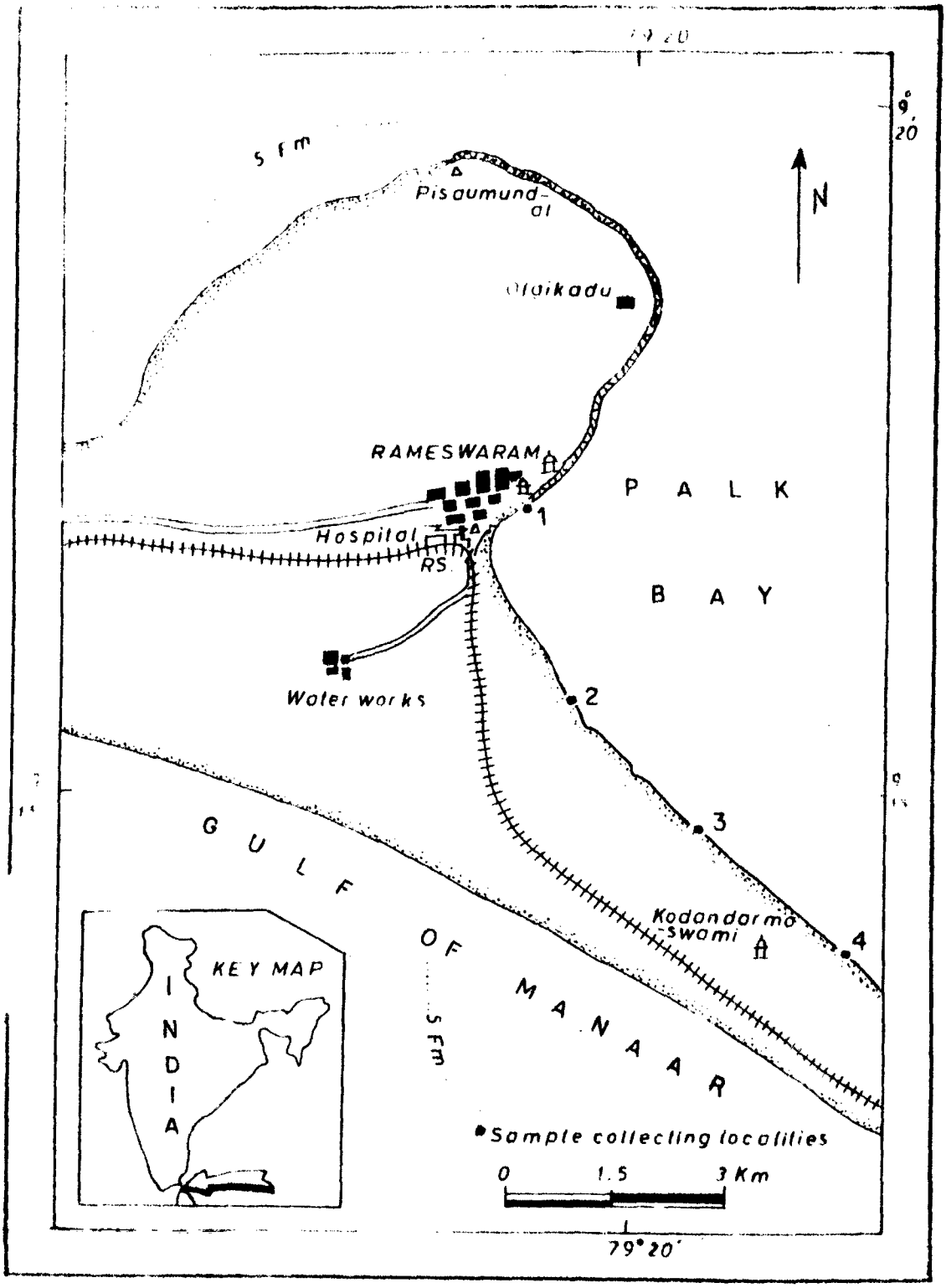
ABSTRACT

Four samples of beach sands were collected from Rameswaram, Tamil Nadu State, for a study of foraminiferal fauna. Thirty species belonging to seventeen genera have been identified and described. A comparison of the foraminiferal fauna is made with those from various localities of the Eastern and Western Coasts of India.

The comparison of the foraminiferal fauna reveals that about twentyone foraminiferal species of this area are common to East and West Coasts. Nine species are confined to Rameswaram.


5 Fm
Pisaumund-
al
Olaikadu
N
RAMESWARAM
P A L K
B A Y
Hospital
RS
Water works
1
2
3
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G U L F
O F
M A N A A R
5 Fm
Kodandarmo
-swami
KEY MAP
I
N
D
I
A
Sample collecting localities
0
1.5
3 Km
9°
20'
79°20'

FIG 1

Chapter -I

1. INTRODUCTION

1.1 AREA OF STUDY

This M.Phil thesis presents a detailed and systemacic account of some Recent foraminifera from four beach sand samples, collected from the Rameswaram beach (E 79°, 19' ; N 9° 13'), south of Madras on the eastern coast of India. The area is included in the Topo Sheet No. 58, 0/7 and 0/3 of the Survey of India (Fig. 1).

1.2 PURPOSE OF STUDY

The present study was originally suggested by Dr. S.N. Bhalla of the Department of Geology, Aligarh Muslim University, Aligarh. The Rameswaram assemblage of Recent foraminifera was compared with those from off Porto Novo (Ragothaman, V. 1974; Rasheed, D.A. and Ragothaman, 1978; Rajasekar N. 1981) and also from other localities in the eastern and western coasts of India. The assemblage was also compared with those from the Coral Sea South of Papua, New Guinea (Rasheed, 1958, 1967 - 68a, 1967 - 68b, 1969 - 70a, 1969-70b and 1969 - 70c) which were earlier compared with materials of the "Challenger" Malay-kerimba Archipelago, Delos and Palermo in the British Museum Natural History, London.

1.3 METHODS OF STUDY

1.3.1 Field Work:

Four sand samples were collected along the Rameswaram

beach (Fig.1) at short regular intervals between Rameswaram temple in the north and Kodandarmaswami temple in the south by Dr. S.N. Bhalla, in 1966. After collection, the sand samples were preserved in polythene bags for further laboratory investigations.

1.3.2. Laboratory Work:

The four beach sand samples were mixed together to form one homogenous sample, which was used for the present investigation.

A weight of 500 gms. of the sample was taken after conning and quartering, washed thoroughly through a AS TM 230 sieve mesh in order to remove the impurities, and dried in a hot air oven. After drying completely the sample was passed through different sieves. The foraminifers from these fractions were obtained by the floatation method (see Cushman, J.A., 1959, p. 27) using carbon tetra chloride. As a check, the sand residue was passed through stereozoom binocular microscope and the foraminiferal tests were hand picked using .00 sable hair brush.

The specimens of foraminiferal test, thus separated were identified and classified according to their families, genera and species and subsequently the classified groups of foraminifera were mounted on different micropalaeontological trays.

The morphological features and dimensions of the hypotypes of the identified 30 species of foraminifera are illustrated in 13 camera, Ludia pencil drawings presented in this work.

1.4 ACKNOWLEDGEMENTS

I am indebted to Prof. S.H. Rasul, Chairman, Department of Geology, Aligarh Muslim University, Aligarh for guiding and helping me in the final stage of the work and also for providing necessary laboratory facilities in the Department in course of the present investigation. This work is based on the samples collected by Dr. S.N. Bhalla, Department of Geology, Aligarh Muslim University, Aligarh.and I am grateful to him for placing the complete set of samples at my disposal and also for suggesting me the topic and guiding this work initially. Also I takes this opportunity to express my gratitude to Prof. D.A. Rasheed, Head, Department of Geology, Madras University, Madras, as well as to Dr. V. Ragothaman, Lecturer, Department of Geology, Madras University, Madras for providing immense help and valuable suggestions before completion of this work.

Thanks are also due to my friends M/S Rajiv Nigam, Abu Talib and K.S. Raghav, for their generous assistance in course of the present study and to my younger brother, Yousuf Abbas for helping me in many other ways. I express my thanks to Mr. Saleemuddin Ahmad, Drawing Assistant in the Department for his help in the preparation of illustrations and to Mr. Moonis A. Khan for arduous task of typing the manuscripts. The financial assistance, granted by the U.G.C. in the form of Junior Research Fellow to the author in course of the present work, is gratefully acknowledged.

1.5. REVIEW OF PREVIOUS INVESTIGATORS

A summary of the previous work done on the Recent Foraminifera from the different beach sands and off-shore regions of the Indian Subcontinent is presented as follows:

1.5.1. Foraminifera from the Bay of Bengal

1.5.2. Foraminifera from the Arabian Sea

1.5.1. FORAMINIFERA FROM THE BAY OF BENGAL

Carter's (1880) work on the foraminifera from the Gulf of Mannar is perhaps considered to be the earliest contribution to recent foraminiferal assemblage from the Indian subcontinent. Ganapati, P.N. and Satyavati, P. (1958) reported about 103 species of foraminifera from the samples collected from the littoral zone along the East Coast extending from Calcutta in the North to Madras in the South. Bhatia, S.B. and Bhalla, S.N. (1959) gave an account of eleven species from the shore sands of Puri, Orissa. Bhalla (1968) studied and described 16 species from the beach sands of Vishakapatnam, A.P. The distribution of foraminiferal fauna of the shelf sediments off Pentakota (South West of Vishakapatnam) was given by Vedantam and Subba Rao (1970). Bhalla (1970) studied some foraminifera from the Madras beach sands. Rasheed

and Ragothaman (1978) reported 70 species of foraminifera from off Porto Novo, South of Madras, and discussed their distribution in relation to various ecological factors. Rajasekar (1981) recorded 59 species of foraminifera from off Tuticorin. Madras (T.N.).

Table 1 presents an idea comparison of recent foraminifera between the study area and other areas in the sub-continent. The geographic locations of the areas covered are also shown in an outline map of India (Fig. 2).

1.5.2 FORAMINIFERA FROM THE ARABIAN SEA:

Chamber, F. (1895) studied the foraminifera from the "Investigator Collections off Laccadives. Stubbing, H.G. (1939) recorded about 300 species from the sediments of John Murray Expedition off the Arabian Sea. Chaudhry, A. and Biswas, B. (1954) described twelve species of foraminifera from the Juhu (Bombay) and Bhogat (Gujarat) beaches. Bhatia, S.B. (1956) Gave an account of some foraminifera from three localities of Western India and found most of them to be Indo-Pacific. Sethulekshmi Amma, J. (1958) recorded 114 species from off Travancore Coast and its back waters. Rocha, A.T. and Ubaldo, M.L. (1964 a) reported some foraminifera from the sands of Diu Gogola and Simbor as well as from Jampore and Baga(Goa) (1964 b). Antony, A.(1968) made a study of the shelf water foraminifera of the Kerala Coast. Generic description of some foraminifera off the Mandgalore Coast was given by Chatterji, B. and Gururaja, M.N. (1967). Kameswara, Rao, K. (1970 b, 1970c, 1971 a) described 84 species of foraminifera from the Gulf of Cambay. He (op.Cit. 1971 b) also reported 92 species from the north Eastern part of the Arabian Sea Seibold, I(1971,72) report

foraminifera from the Cochin Coastalarea. Bhatia, S.B. and Kumar, S. (1976) reported some foraminifera from Anjidiv Islands of the West Coast of India. Jain, S.P. and Bhatia, S.B. (1978) recorded 37 species of benthonic foraminifera from the beach samples, Mandiv, Kutch. A check list of benethonic foraminiferids from the Dabhol-Vengurlaregion was given by Rijiv Nigam et al, in 1979.

Chapter -II

2. SYSTEMATIC PALAEONTOLOGY:

2.1 CLASSIFICATION:

In the present work, the widely employed system of classification, proposed by A.R. Loeblich Jr. and H. Tappan (Treatise on invetebrate Palaeontology-Directed and edited by R.C. Moore, part C, protista 2, Sarcodina, 1964), has been followed.

In the following pages thirty species and varieties of foraminifera belonging to seventeen genera, eleven families, six superfamilies and three sub-orders have been described and discussed in some detail with the help of many illustrations.

For specific identification and faunal comparison, relevant publications available in the Department of Geology, Aligarh Muslim University, Aligarh, and in the Department of Geology, University of Madras, have been consulted.

The hypotypes are deposited in the Geology Department, Aligarh Muslim University, Aligarh, the index numbers being AMUGD Cat. No. MF-200 to MF 229.

	Order	FORAMINIFERIDA	Eichwald, 1830
	Suborder	TEXTULARIINA	Delage and Herouard, 1896
2.1.1.	Superfamily	LITUOLACEA	De Blainville, 1825
	Family	TEXTULARIIDAE	Ehrenberg, 1838
	Subfamily	TEXTULARIINAE	Ehrenberg, 1838
	Genus	TEXTULARIA	De Blainville, 1824

Textularia conica d'Orbigny:

Pl. 1, Figs. 1 a,b.

Textularia conica d' Orbigny, 1839, De la Sagra, Hist, Fis. Pol. Nat. Cuba, Foraminifera, Vol. 8, p. 143, pl. 1, Figs. 19 - 20;-Bhatia, 1956, Cont. Cushman Found. Foram, Res. Vol.7 p. 17, pl.1, Fig.2;-Sethulekshmi Amma, 1958, Bull. Cent. Res. Inst. Univ., Kerala, Vol.6, No.1, p. 40, pl.2, Figs. 59, a,b; Rajasekar, 1981, pp. 10 - 11. pl.1, Figs. 5 a - c.

Description: The small, laterally somewhat compressed, biserial test, is broader than longer, sub-circular in apertural view and rather conical in shape, about 12 - 14 biserially arranged arcuate chambers are much broader than higher. They increase in size rapidly. The distinct arcuate sutures are slightly depressed. In the early portion the periphery is somewhat angled but becomes rounded in the latter portion. The finely arenaceous wall consists of smoothly cemented sand grains. The distinct elongate slit-like re-entrant aperture occurs at the base of the sub-oval slightly concave apertural face of the last-formed chamber.

Remarks: Textularia conica is a cosmopolitan species recorded from many areas all over the world.

The comparatively bigger size, the less angled periphery are differentiating features of this species from T. Pseudotrochus Cushman to which it resembles.

This species which occurs rarely in the beach sands of Rameswaram is similar to that from the shore sands of the Western Coast (Bhatia, 1956) and from the Travancore Coast (Sethulekshmi Amma, 1958).

Antony (1968), Almieda, F. and Setty, M.G.A.P (1972) ~~and Seibold (1975)~~ have reported the occurrence of this species from various other localities of India.

Rajasekar, (1981) has also reported T. conica from off Tuticorin Coast, South India.

Hypotype: height 0.35 m.m., breadth 0.43 m.m. - AMUGD Cat. NO. MF - 200

Textularia cf. **T. gramen** d' Orbigny.

Pl. 1, Figs. 2 a,b.

Description: The small, elongate and laterally comperessed biserial test is about twice as long as broad and consists of about 16 - 18 chambers. In the initial portion the chamber is less distinct, whereas in the later portion it is distinctly subrectangular and gradually increasing in size. The sutures are distinct and slightly depressed. They meet the periphery almost at right angles and ziz-zag in the middle. The rounded periphery is slightly lobulate. The finely arenaceous wall consisting of minute sand grains is somewhat smoothly finished. The distinct re-entrant slit-like aperture occurs at the base of the last formed chamber.

Remarks: Since only one good specimen was found in the sample, the specific identification was rather difficult. The present species which resembles **T. gramen** d' Orbigny, could be differentiated from the latter by its smaller size and sub-rectangular test.

Hypotype: length 0.95 m.m., breadth 0.55 m.m. - AMUGD Cat. No. MF - 201.

Textularia pseudorugosa Lacroix

Pl. 1, Figs. 3 a,b.

Textularia pseudorugosa Lacroix, 1932, Bull. 591, p.19, Fig.19;- Braga, 1960, Junta de invest. do ult. No.67, p. 65, pl.3, Fig.2

Description: The small and laterally compressed biserial test is about 01& 1/2 times as long as broad, slightly broadly oval (sub-oval) in its apertural view and consists of about 10 - 12 chambers. The arcuate sub-triangular chambers are much broader than higher, and rapidly increase in size with the last two chambers being slightly inflated. The distinct arcuate sutures are slightly depressed and assume zig-zag pattern in the middle. The broadly rounded periphery is lobulate in the later portion. The smoothly finished arenaceous wall consists of fine to medium sand grains. The elogate slit-like re-entrant aperture occurs at the base of sub-oval apertural face of the last formed chamber.

Remarks: The present species is exactly similar to that reported by Braga, J.M. (1960) from the Coast of Mocambique. The occurrence of this species is however ~~occurs~~ rare in the present study area. It has also not been reported earlier from any Indian locality.

Hypotype: Length 0.77 m.m., breadth 0.60 m.m. - AMUGD Cat. No. MF - 202.

Suborder MILIOLINA Delage and Herouard, 1896

2.1.2. Superfamily MILIOLACEA Ehrenberg, 1839

Family NUMMULOCULARIIDAE Jones, 1875

Subfamily SPIROLOCULININAE Wiesner, 1920

Genus SPIROLOCULINA d' Orbigny, 1826

Spiroloculina aequa Cushman

Pl.1, Figs. 4 a,b

Spiroloculina ~~aequa~~ antillarum var. aequa Cushman, 1932, ~~Cushman, 1932~~, Albatross, p. 38, pl.9, Figs 13 a,b.

Spiroloculina aequa Cushman, 1944, Spec. Publ. 12, p. 59, pl. 8, Figs. 13 - 15; - Jain and Bhatia, 1978, Proc. VII Indian Coll. Micropal. Strat, p. 155, pl. 1, Fig. A.

Description: The large sub-elliptical planispiral test is about 2 - 2 1/2 times as long as broad bilaterally compressed and slightly depressed in the middle. Both the proximal and distal ~~their~~ ends of the end chambers are produced beyond its outline. The length of the chambers is much greater than its breadth. They are arcuate and tubular, half a coil in length almost of equal breadth throughout and rather rapidly increasing in size. The sutures are distincted & depressed. The calcareous imperforate wall is smooth and shining. The aperture is rounded and occurs at the distal end of the last formed chamber with a short neck. It has a prominent bifid tooth.

Remarks: This species is of rare occurrence in the study area. The specimen is much similar to the figures and description of the species given by Cushman (1932). Others who reported this species from the Indian localities include Kameswara Rao, K. (1970 b) from the Gulf of Cambay and Jain and Bhatia (1978) from Mandvi beach Kutch, East Coast of India.

Hypotype: length 0.75 m.m., breadth 0.40 m.m. - AMUKD Cat. No. MF-203.

Spiroloculina antillarum d' Orbigny

Pl. 1, Figs. 5 a,b.

Spiroloculina antillarum d' Orbigny 1839, in Dela Sagra, Hist. Fis. Pol. Nat. Cuba, Foraminifera, P.166, Pl.9 Figs. 3,4;- Bhalla, 1968, Bull. Nat. Inst. India No. 38, pp. 378 - 380 Pl.1, Figs. 7 a,b.

Description: The large sub-elliptical test is planispiral and concave on either sides and nearly twice as long as broad. The elongated tubular chambers are arcuate and half a coil in length. The early chambers are somewhat overlaped by the rapidly increasing later ones. The distinct sutures are depressed. The periphery is broadly rounded. The polished, calcareous and porcellaneous wall is ornamented with many fine longitudinal striations running almost parallel to the entire periphery. Distally, the end chamber is elongated to from a small cylindrical neck with a circular aperture having a short bifid tooth.

Remarks: This species could be differentiated from S. corrugata Cushman by its comparatively smaller size, lesser number of striae and relatively thicker test.

This species occurs rarely in the study area. Sethulekshmi Amma (1958), Rocha and Ubaldo (1964 a) Bhalla (1968), and Antony (1968) have also reported the occurrence

of Spiroloculina antillarum from some other Indian localities.

Hypotype: Length 0.95 m.m., Width 0.55 m.m. - AMUGD Cat. No. MF - 204.

Spiroloculina communis Cushman and Todd.

Pl. 1 Figs. 6 a,b.

Spiroloculina excavata d' Orbigny - Brady (Not d' Orbigny), 1884, Rept. Voy. Chall; Zool. Vol. 9, p. 151, Pl.9, Figs. 5-6; - Sethulekshmi Amma, 1953 Centr. Res. Inst. Kerala Univ. Bull. Vol. 6 No.1 Ser. c, p.3, Pl.1, Fig.3.

Spiroloculina grateloupi d' Orbigny - Cushman (Not d' Orbigny) 1917, U.S. Nat: Mus. Bull. 71, pt.6, p. 31, Pl.4, Figs.4-5;- Ganpati and Satyavati, 1958, Andhra Univ. Mem. Oceanogr. Ser, 62, Vol.II, Pl.11, Fig.36.

Spiroloculina Communis Cushman and Todd, 1944, Cushman Lab. Foram, Res. Specl. Publ.11, p.63, Pl.9, Figs. 4-5, 7 and 8; - Albani, 1965, Cushman Found. Foram Res. Coutr. Vol. 16 pt.2, p.61, Pl.6 Fig.6;-Rasheed, 1967-68b, Madras Univ. Jour. 'B', Vol.37 and 38 p.48, pl.26, fig 14 - 16;-Ragothaman, 1974, Doctorate thesis (Unpublished) Univ. Madras, pp. 39-41, pl.2, Figs. 12 - 13; Rajasekar, 1981, pp. 13 - 14, pl.1, Figs.11-12.

Description: The large sub-oval test is planispiral and about 2 - 2 1/2 times as long as broad, slightly compressed and laterally excavated in the middle. The distal end of the end chamber is more extended beyond the outline than the proximal end. The chambers being much longer than broad are half a coil in length, almost equal in width throughout and arcuate in the middle. They increase in size

rapidly. The sutures are distinct and depressed. The broad periphery is squarely truncated or concavein shape.

At the distal end of the last formed chamber, the distinct circular aperture has a prominent cylindrical neck, a thin lip and a prominent bifid tooth.

Remarks: S. communis is one of the these abundantly occurring species in Rameswaram. There are many earlier reports of the occurrence of this Indo-Pacific species from the shallow-water regimes from the different parts of the world. It is one of the common occurring species belonging to the above genus.

This species was also reported from other parts of India by Sethulekshmi Amma (1956), Bhalla (1968) and Rajgopalan (1974).

The specimen compares well with that identified from the Vishakapatnam beach sands (Bhalla, 1968).

Hypotype: Length 0.90 m.m., breadth 0.40 m.m. - AMUGD Cat. No. MF - 205.

Subfamily NODOBACULARIINAE Cushman, 1927

Genus VERTEBRALINA d' d'Orbigny, 1926

Vertebralina striata d' Orbigny

Pl. 1, Figs. 7 a - c.

Vertebralina striata d' Orbigny, 1826, Lab. Method Cephalopodes p. 283; - Sethulekshmi Amma, 1958, Bull. Cent. Res. Inst. Ser. C. Vol. 6, No.1, pp. 31 - 32, Pl.1, Fig. 45; - Rasheed, 1967 - 68 b, Madras Univ. Jour. Vols, 37 & 38, p. 57, Pl.17, Figs. 13 - 14; - Rajasekar, 1981, pp. 16 - 18, Pl.1, Figs. 9-10.

Description: The sub-circular and laterally compressed test is sub-trochoid, more longer than broader, partially involute on the side from which the aperture is visible. The early chambers, which are preceeded by a proloculum, appear overlapped and indistinct. The chambers of the final whorl are almost as long as broad and increase in size rapidly. The sutures are distinct and depressed.

The periphery is sub-acute and carinate. The imperforate calcareous shining wall is ornamented with many longitudinal striae that runs parallel to the periphery. The s aparture, which is visible only from the involute side of the test, is arcuate, broad and slit-like with a phialine lip.

Remarks: The occurrence of aperture on one side of the test is the only recognisable characteristic of this form. While describing Vertebralina striata from the

Coral Sea, Rasheed (1967-68 b) reported the occurrence of two similar forms, one with additional rectilinear chambers and the other, without any rectilinear chamber.

This is the only specimen from the beach sands of Rameswaram which has no additional rectilinear chamber so it bears similarly to Rasheed's (op. Cit.) second form having no rectilinear chamber.

Sethulakshmi Amma (1953) reported this species from the Travancore coast kerala.

Hypotype: Length 0.55 m.m., breadth 0.54 m.m., thickness 0.10 m.m AMUGD Cat. No. MF - 206.

Family MILIOLIDAE Ehrenberg, 1839

Subfamily QUINQUELOCULININAE Cushman, 1917

Genus QUINQUELOCULINA d' Orbigny, 1826

Quinquelocnlina curta Cushman

Pl. 1, Figs. 8 a - c.

Quinqueloculina disparalis d' Orbigny var. curta Cushman, 1917, U.S. Nat. Mus. Bull. No. 71, p. 49, Pl. 14, Figs. 2 a,c, text Fig. 30

Quinqueloculina curta Cushman - Bhatia and Kumar, 1976, Mar, Sedi. Spec. Bubl. 1, pp. 243 - 244, Pl. 1, Figs. 8 - 12.

Description: The small sub-oval test is slightly longer than broader. Externally the five quinqueloculine chambers with four on one side, and three on the other, are visible. The tubular chambers are arcuate and equal in breadth throughout. The proximal end of the last formed chamber and distal end of the penultimate chambers are slightly extended beyond the outline of the test. The sutures are distinct and depressed. The periphery is broadly rounded. The thin and polished porcellaneous walls are ornamented with many longitudinal striations. Distally, the end chamber opens out into a semi-circular aperture with a simple tooth.

Remarks: The species which is of rare occurrence in the study

area is similar to that described from Anjdiv, Island by Bhatia and Kumar (1976). According to Bhatia and Kumar (op. Cit.). Quinqueloculina curta is a well-known Indo-Pacific species which shows variation in its shape, size and also ornamentation.

Hypotype: Length 0.65 m.m., breadth 0.52 m.m., thickness 0.40 m.m. AMUGD Cat. No. MF-207.

Quinqueloculina seminulum (Linne)

Pl. 2, Figs. 9 a-c.

Serpula seminulum Linne, 1776, Syst, Nat. ed. 12, p. 1264, tome. 1, para. 2.

Quiqueloculina seminulum (Linne) Cushman, 1929, U.S. Nat. Mus., Bull. 104, pt. 6, p. 24, Pl.2, Figs. 1,2; - Bhatia and Bhalla, 1959, Jour. Pal. Soc. India, Vol. 4, p. 79 Pl.1, Figs. 1 a-b; - Rasheed, 1967 - 68b, Madras Univ. Jour. Vol. 37 - 38, p.26, Pl. 6. Figs. 2 a-c; - Bhalla, 1968 Bull. Nat. Inst. Sci, India, No. 38 p. 380, Pl. 1, Figs, 1 a-b.

Description: The test is small, sub-oval, slightly longer than broader and sub-triangular in apertural view. Externally, five quinqueloculine chambers, four from one side and three from the other side are visible. The much longer than broad arcuate chambers are almost uniform in breadth from the proximal to distal ends. The sutures are distinct and depressed. The periphery is broadly rounded. The thin and porcellaneous calcareous wall is smooth and shining. At the distal end of the end chamber, the sub-oval aperture has a prominent simple tooth.

Remarks: Quinqueloculina seminulum is considered to be a cosmopolitan species and has numerous records of occurrences from shallow waters - cold or warm, all over the world.

In the study area this species occurs rarely. It is similar to the one described by Bhalla (1968) from the beach sands of Vishakapatnam.

This species was reported from India by Gnanamuthu, C.P. (1943), Bhatia and Bhalla (1959), Bhalla (1968, 70), Rao, T.V. and Rao, M.S. (1974), Rasheed and Ragothaman (1978) from the different localities on the Eastern Coast. Bhatia (1956), Antony (1968), Rao (1970 a) and Bhatia and Kumar (1976) also recorded the same species from the different parts on the Western Coast.

Hypotype: Length 0.42 m.m., breadth 0.30 m.m., thickness 0.24 m.m. AMU3D Cat. No. MF-208.

Quinqueloculina vulgaris d' Orbigny

Pl.2, Figs. 10 a-c.

Quinqueloculina vulgaris d' Orbigny, 1826, p. 302; Sethulekshmi Amma, 1958, Bull. Cent. Res. Int. Kerala, Univ. Ser. c. Vol. 6, No.1, pp. 4 - 5, pl.1, Fig. 5; - Bhalla, 1970, Cent. Cushman Found, Forman, Res. Vol. 21, pt.4 p. 157, Pl.20, Figs. 3 a,b.

Description: The small sub-circular test is somewhat stout, almost as long as broad and sub-triangular in apertural view. The Relatively longer than broader tubular arcuate chambers are quiqueloculine and almost equal in breadth from proximal to distal end. The distinct sutures are depressed. The periphery is broadly rounded. The thick and calcareous porcellaneous wall is smooth. At the distal end of the end chamber, the small sub-circular aperture has a short, blunted and simple tooth.

Remarks: Quinqueloculina vulgaris which occurs commonly in the Rameswaram beach sample, is cosmopolitan species that has been reported from many areas all over the world.

From India, it has been reported by Sethulekshmi Amma (1958) from Travancore Coast, Ganapati and Satyavati (1958) from off Vishkapatnam Coast, Roche and Ubaldo (1964 a) from Diu, Gogola and Simbor, Antony (1968) from Kerala, and Bhalla (1970) from Madras beach.

Hypotype: Length 0.40 m.m., breadth 0.36 m.m., thickness 0.25 m.m. AMUMD Cat. No. MF-209.

Quinqueloculina sp. indet.

Pl. 2, Figs 11 a - c.

Description: The small sub-elliptical test is almost as long as broad, broadest near the middle and sub-triangular in apertural view. Externally, five quinqueloculine chambers with four on one side and three on the other side are visible. The elongated and arcuate chambers which are much longer than broader and have almost equal width from the proximal to distal end (thicker near the central part and thinner towards the end). The sutures are distinct and depressed. The calcareous imperforate wall is ornamented, especially near the periphery with some sub-oval irregular pits, (may be formed by longitudinal and transverse costae). The periphery is rounded. At the distal end of the end chamber, the oval aperture has a simple tooth.

Remarks: In the Rameswaram beach sand material only one specimen of the said species has been encountered. Though it somewhat resembles Q. pseudoreticulata Parr, the smaller size of the present specimen and less prominent pitted ornamentation and tooth, differentiate the same from Q. pseudoreticulata. Since only a solitary specimen was found in the collection a more precise identification is difficult in this case.

Hypotype: Length 0.40 m.m., breadth 0.37 m.m., thickness 0.25 m.m. AMUMD Cat. No. MF-210.

Genus PATEDRIS Loeblich and Tappan, 1953.

Pateoris sp. indet.

Pl.2, Figs.12 a - c.

Description: Bilaterally the small sub-circular test is slightly compressed. The small early chambers are quinqueloculine whereas the chambers of the final whorl are planispiral (with more than two chambers). The chambers are tubular much arcuate and slightly inflated. The sutures are distinct and depressed. The thin calcareous porcellaneous wall is smooth and shining. At the distal end of the end chamber, the large and somewhat arch-shaped aperture has a thin lip and a small flat tooth.

Remarks: Since only one specimen of the species has been found in the material, specific identification could not be made. This may probably be the first report of this species from the Indian Waters.

Hypotype: max. diam. 0.47 m.m., thickness 0.21 m.m. - AMUGD Cat. No. MF-211.

Genus TRILOCULINA d' Orbigny, 1826

Triloculina insignis (Brady)

Pl.2, Figs.13 a - c

Miliolina insignis Brady 1884, rept. Voy. Chall. Zool. Vol. 9, p. 165, Pl.4, Figs 8 - 10.

Triloculina insignis Cushman 1917, U.S. Nat. Mus. Bull.71, Pt. 6, p. 64, Pl.XVII, Figs 2 a,b; - Sethulekshmi Amma, 1958, Cent. Res. Inst. Univ. Kerala Ser. c. Vol. 6, No.1, pp. 8-9, Figs. 14 a,b.

Description: The small to medium sized sub-oval test is about 1 & 1/2 times as long as broad and sub-triangular in apertural view. The three externally visible triloculine chambers are almost tubular. Its length is much greater than breadth, and shape is slightly arcuate. The end chamber is broadest near the proximal end. The sutures are distinct and depressed. The periphery is broadly rounded. The shining and polished calcareous wall is ornamented with many longitudinal striae that are slightly inclined to the periphery. The distal end of the end chamber opens to a small circular aperture having a short bifid tooth.

Remarks: Triloculina insignis is one of the abundantly occurring species in the beach sands of Rameswaram. The specimen is similar to the figures & description of this species given by Sethulekshmi Amma (1958) from the Travancore Coast. This was also reported by Antony (1968) from the shelf waters of Kerala, West Coast of India.

Hypotype: Length 0.65 m.m. width 0.50 m.m. - AMUGD Ct. No. MF-212.

Triloculina terquemiana (Brady)

Pl.2, Figs. 14 a,b

Miliolina terquemiana Brady, 1884 Challenger Rept., Zool., Vol.9 p.106, pl.114, Figs 1 a-b.

Triloculina terquemiana Cushman, 1917, U.S. Nat. Mus. Bull. No.71, pt. 6, p. 72, Pl. 27, Fig.2; - Bhatia, 1956, Cushman found. Foram. Res. Contr. Vol. VIII, pt.1, pl.2, Fig.3;- Bhalla, 1968, Bull. Nat. Inst. Sci, Ind. No.30, p. 381, pl. 1 Figs. 5 a-b;- Rajasekar, 1981, pp. 30 - 31, pl.3, Fig. 67.

Description: The small test is about 1 and 1/2 times as long as broad and sub-triangular in its apertural view. The three externally visible chambers are broadest near the middle and become narrower towards the proximal and distal ends. The sutures are distinct and depressed. The periphery is broadly rounded. The calcareous porcellaneous wall is shinning and the surface is ornamented with many fine longitudinal striae running parallel to the periphery. The broadly oval aperture has a small bifid tooth.

Remarks: Triloculina terquemiana is one of the abundantly occurring species in the Rameshwaram beach sands. The species can be differenciated from T. tricarinata d' Orbigny to which it resembles, in the possession of striated ornamentation and in the broadly oval nature of the aperture

From Indian regions Bhatia (1956) reported this form the shore sands of Western India, Sethulekshmi Amma (1958) from Travancore, Rocha and Ubaldo (1964 a) from Diu, Gegola and Simbor, Bhalla (1968) from Vishakapatnam beach sands and Rajasakar (1981) from off Tuticorin.

Hypotype: Length 0.70 m.m., breadth 0.50 m.m. - AMUGD Cat. No. MF- 213.

Triloculina tricarinata d' Orbigny

Pl. 2, Figs. 15 a,b.

Triloculina tricarinata d' Orbigny, 1826, Ann. Sci, Nat. Vol.7 p. 299, No.7, Modeles No.945;-Sethulekshmi Amma, 1958, Cent. Res. Inst. Kerala Univ. Bull. Vol.6 No.1,p.5, Pl.1, Fig. 12; - Rasheed, 1967-68 b, Madras Univ. Jour.B Vol. 37-38, p. 33, Pl.10, Figs. 1 a-c; - Bhalla, 1968, Bull., N.I.S.I. No. 38, p. 381, Pl.1, Figs. 3 a-b; - Antony, 1968, Bull. Deptt. Mar. Biol. Oceongr, p. 38, Pl.2, Figs.13 a-b; Rajasekar, 1981, pp. 31, pl.3, Figs. 4-5.

Description: The small trihedral somewhat longer than broad test is triangular in apertural view. The three externally visible chambers are triloculine, broadest in the middle and become narrower towards the end. The distinct sutures are slightly depressed. The periphery is sub-acute. The smooth calcareous, porcellaneous wall is shinning and polished. The sub-triangular aperture has got a large bifid tooth.

Remarks: In the Rameswaram beach samples Triloculina tricarinata occurs rarely and is similar to those from Vishakapatnam beach sands (Bhalla, 1968).

Bhatia (1956) reported the same species from the shore sands of Western India, Ganapati and Satyarthi(1958) from off. Vishakapatnam, Sethulekshmi Amma (1958) from

Travancore Coast, Antony (1968) from Kerala, Bhatia and Kumar (1976) from Anjdiv Island and Rajasekar (1981) from off. Tuticorin.

Hypotype: Length 0.50 m.m., Width 0.40 m.m. - AMUGD Cat. No. MF -214.

Triloculina trigonula (Lamarck)

Pl.2, Figs. 16 a-b.

Miliolites trigonula Lamarck, 1804, Ann. Mus. Nat. Hist. Paris, tom 5, Pl.17(15), Fig.4.

Miliolina trigonula Brady, 1884, Rept. Voy. Challenger, Zool. Vol.9, p. 164, Pl.3, Figs. 14 - 16.

Triloculina trigonula (Lamarck) d' Orbigny, 1826, Ann. Sci, Nat. Vol. 7, p. 299, Pl.16, Figs. 5-9; - Bhatia and Bhalla (1959) J. Paleont. Soc. India, Vol.4, p. 79, Pl.1, Figs,5 a-b; - Rasheed, 1967 - 68 b, Madras Univ. Journ 'B' Vols. 37 and 38, p. 34, Pl.10 Fig.2, Bhalla, 1968, N.I.S.I. No. 38 p. 382, Pl.1. Figs. 2 a-b;- Rajasekar, 1981, pp. 33 - 34, Pl.3, Figs. 10 - 11.

Description: The small test is about 1 and 1/2 times as long as its breadth and sub-triangular in apertural view. Three triloculine chambers are externally visible. The chambers are slightly inflated and curved. They are broadest in the middle and becomes narrower towards the proximal and distal ends. The sutures are distinct and depressed. The periphery is sub-rounded. The calcareous porecellaneous wall is smooth and polished. At the distal end of the end chamber, the sub-oval aperture has a bifid tooth emerging from inside the aperture.

Remarks: Triloculina trigonula occurs rarely in study

beach samples and appears similar to that reported from Vishakapatnam (Bhalla, 1968) and also from off Tuticorin Coast (Rajasekar, 1981).

This species resembles T. tricarinata d' Orbigny, but differs from the latter in having a longer test, rounded periphery and slightly inflated chambers.

Bhatia and Bhalla (1959) reported the species from the Puri beach sands and Bhalla (1970) from Marina beach sands. Rocha and ubaldo (1964 a) reported the same from Diu, Gogola and Simbor and Rao (1976), from the Gulf of Cambay, both on the Indian West Coast.

Hypotype: Length 0.55 m.m., Width 0.40 m.m. - AMUGD Cat. No. MF-215.

	Suborder	ROTALIINA	Delage and Herouard, 1896
2.1.3.	Superfamily	NODOSARIACEA	Ehrenberg, 1838
	Family	GLANDULINIDAE	Reuss, 1860
	Subfamily	GLANDULININAE	Reuss, 1860
	Genus	GLANDULINA	D' Orbigny, 1839

Glandulina laevigata d'Orbigny

Pl.2, Fig. 17

Nodosaria (Glandulina) laevigata d' Orbigny, 1826

Ann. Sci. Nat. Vol.7, p. 252, Pl. 10, Figs. 1-3.

Glandulina laevigata (d' Orbigny) Cushman and Ozawa, 1930, Proc. Nat. Mus. Vol. 77, Pl.40, Figs. 1 a,b; - Bhatia, 1955. J. Pal. Vol. 29 No.4, p. 675; Pl. 67, Fig. 25; - Todd and Bronnimann, 1957, Cushman Found, Foram Res. Spec. Publ. No.3, Pl.5,Fig.23.

Description: The elongate and medium sized sub-oval test is about 1&1/2 times as long as breadth. It has a broadly rounded initial end and a bluntly rounded apertural end. It is broadest slightly below the middle and tapers towards both the ends and more so towards the apertural side. The slightly inflated chambers are rather distinct and arranged biserially in the early portion and uniserially the last few ones. The thin sutures are almost flush with the surface. The periphery is broadly rounded. The finely perforate calcareous wall is thick and sub-translucent. The terminal aperture is radiating and slightly projecting.

Remarks: The soliary entire specimen of Glandulina laevigata, which was found in the study areas is similar to the figures and description of the species recorded from the Gulf of Paria (Todd, R. and Bronnimann, P., 1957). Probably this may be the first report of Glandulina laevigata from the Recent beach sediments of India.

Hypotype: Length 0.72 m.m., breadth 0.45 m.m. - AMUGD Cat. No. MF-216.

2.1.4. Superfamily DISCORBACEA Ehrenberg, 1838

Family DISCORBIDAE Ehrenberg, 1838

Subfamily DISCORBINAE Ehrenberg, 1838

Genus ROSALINA d' Orbigny, 1826

Rosalina floridana (Cushman)

Pl. 3, Figs 18 a-c.

Discorbis floridana Cushman, 1922 Carnegie Inst. Publ.311, p. 39, Pl.5, Figs. 11-12.

Rosalina floridana (Cushman) Parker, 1954, Bull. Mus. Comp. Zool. (Harvard College) Vol. 111, No. 10, pp. 524-525, Pl.8, Figs. 19-20; - Todd, 1965 U.S. Nat. Mus. Bull. 161, pp. 10 - 11, Pl.3, Figs. 1 and 3. Pl.4, Fig. 5.

Description: The small trochoid test is sub-circular with a convex dorsal side and slightly concave ventral side. The umbilical region is depressed. The test consists of about 2&1/2 to 3 whorls. On the dorsal side the chambers of all the whorls which are exposed are sub-rectangular. They are higher than broader excepting the last two chambers which are broader than higher. They increase gradually in size and become slightly inflated and lobulate. On the ventral side, only the six chambers of the last formed whorl which are visible, are subtriangular with their pointed ends facing the umbilicus and are slightly inflated. The last chamber occupies about 1/3

of the size of the test. On its dorsal side the distinct sutures are arcuate and depressed and on the ventural side they are depressed and radiating. The rounded periphery is sub-acute. The calcareous sub-translucent wall is perforate, the perforations are conspicuous on the dorsal side. On the ventral side the aperture is a low interio-marginal arch at the base of the final chamber.

Remarks: This species is rare in the beach samples of Rameswaram and appears similar to the figures and description of the one reported from the Tropical Pacific (Todd, 1965).

Hypotype: Length 0.37 m.m., breadth 0.31 m.m., thickness 0.71 m.m. AMUGD Cat. No. MF-217.

Family GLABRATELLIDAE Loeblich and Tappan, 1964.

Genus GLABRATELLA Dorren, 1948.

Glabratella sp. indet.

Pl. 3, Figs. 19 a-c.

Description: The small, trochoid sub-rounded test has a convex dorsal side and an almost plane to slightly convex ventral side. The dorsal side consists of about 2-2&1/2 whorls and on the same side the chambers, arcuate which are arcuate & higher than broader are sub-rectangular, gradually increase in rise and appear inflated. On the ventral side the six chambers of the last whorl are subtriangular with their pointed ends projecting towards the umbilical region. On the dorsal side the arcuate, limbate sutures are slightly depressed whereas on the ventral side they are depressed and radial. The rounded periphery is lobulate. The thin shining calcareous wall is coarsely perforated on the dorsal side whereas on the ventral side the chambers are ornamented with a few radial striations. The umbilical aperture is rounded and occurs at the base of the last formed chamber on the ventral side.

Remarks: This is one of the abundantly occurring species in the beach sands of Rameswaram.

Hypotype: Length 0.50 m.m., breadth 0.45 m.m., thickness 0.22 m.m. AMUMD Cat. No. MF-218.

2.1.5. Superfamily ROTALIACEA Ehrenberg, 1839

Family ROTALIIDAE Ehrenberg, 1839

Subfamily ROTALIINAE Ehrenberg, 1839

Genus AMMONIA Brunnich, 1772

AMMONIA annectens (Parker and Jones)

Pl.3, Figs. 20 a-c.

Rotalia beccarii (Linnaeus) var. annectens Parker and Jones, 1865, Philos. Trans, Vol. 155, p. 387, 422, Pl.19, Figs.11 a-c

Streblus annecteps (Parker and Jones) Bhatia, 1956, Cont. Cushman Found Foram. Res. Vol.7 pt.1; p.22, Pl.3, Figs.1,2; - Bhatia and Bhalla, 1959, J. Palaeont. Soc. India Vol. IV, p. 79. Pl.2, Figs. 1 a-c.

Ammonia annectens: (Parker and Jones) Bhalla, 1970, Contr. Cushman Found. Foram. Res. Vol. 26, pt. 4, p. 158, Pl.20, Figs. 8 a-c.

Description: The small, rounded trochoid test is almost equally biconvex. About three whorls are exposed on the dorsal side and only the last whorl on the ventral side. On the dorsal side, the subrectangular chambers are higher than broader, whereas on the ventral side all the 10 - 12 chambers of the last whorl are sub-rectangular with their pointed ends projected towards the umbilical region. They gradually increase in size and appear slightly inflated. The distinct sutures on the dorsal side are arcuate, limbate and slightly raised while on the ventral side, they are depressed, radial and straight. On the ventral side, the

the umbilical area is almost entirely covered by one or two solid plugs of the shell substance. The size of the plugs is variable. The rounded periphery is lobulate. The thin calcareous wall is translucent and finely perforated, and on the ventral side, the aperture is represented by two openings at the base of apertural face of the last formed chamber, known as proto and deutero-foramen.

Remarks: Ammonia anmectens happens to be a well-known Indo-Pacific species which is common in the present material. It shows a wide range of variation in the shape and size of the test and also in the number of chambers. Bhatia and Bhalla (1959) reported this species from Puri beach sands, and Bhalla (1970) from Marina beach sands. Bhatia (1956) recorded the species from Juhu Chaupathy and Bhogat beaches and Rocha and Ubaldo (1964, a) from Diu, Gagola Simbor and from Jampore and Baga beaches (1964,b).

Hypotype: Length 0.40 m.m., breadth 0.35 m.m., thickness 0.20 m.m. AMUGD Cat. No. MF-219.

Ammonia beccarii (Linne) Var. tepida Cushman.

Pl.3, Figs. 21 a-c.

Rotalia beccarii (Linne) Var. tepida Cushman, 1926, Carnegie Inst., Publ. 344, p. 79, Pl.1, Fig. 9; - Rotalia beccarii (Linne) & variants - Rasheed, 1969-70c. Madras Univ. Jour. 'B' Vol. 39 & 40. pp. 157-159, Pl.2, Figs. 11-12 & 17.

Streblus beccarii (Linne) tepida Todd and Bronnimann, 1957, Cushman Found. Foram. Res. spec. Publ. No.3, p. 38, Pl.10, Figs. 5 - 11.

Ammonia beccarii (Linne) var. tepida Cushman, Nagothaman, 1974, Dectorate thesis (unpublished) Univ., Madras, pp. 91 - 93, Pl.8, Figs. 5 - 7; - Rajasekar, 1981, pp. 57 - 59, Pl. 5. Figs. 15 - 17.

Description: The small sub-circular test is almost equally biconvex. On the dorsal side, the sub-rectangular chambers of about three whorls are almost as high as broad, increase in size gradually and appear slightly inflated. On the ventral side, the eight to nine chambers of the last formed whorl are subtriangular with their pointed ends projected towards the umbilical region. On the same side, near the umbilicus, the chambers are separated from one another forming a shallow cavity in the umbilical region. Dorsally, the distinct slightly limbate sutures are almost flush with the surface and slightly oblique, whereas

ventrally they are depressed and radial. The rounded periphery is lobulate. The calcareous wall is finely perforated. The small elongate aperture is ventral and occurs beneath the inner margin of the last formed chamber.

Remarks: Ammonia beccarii var. tepida occurs rarely in the present area. This species has been reported from many parts of the world including the Atlantic and Pacific Oceans.

The characteristic feature of this species is the formation of a shallow cavity around the umbilical region on the ventral side of the test due to separation of the chambers near the umbilicus.

Seibold (1971, 72) reported the same species from the West Coast of India and Rajasekar (1981) from off Tuticorin, Eastern Coast of India.

Hypotype: Length 0.36 m.m., breadth 0.28 m.m., thickness 0.18 m.m. AMUGD Cat. No. MF-220.

Ammonia sobrina (Shupack)

Pl. 3, Figs. 22 a-c.

Streblus beccarii var. sobrina (Shupack) Todd and Bronnimann, 1957, Cushman Found. Foram. Res. countr. Spec. Publ. No.3, p.38, pl. 10, Figs. 1 a-c.

Ammonia sobrina (Shupack) Seibold, 1971 Palaont. Z. Vol.45, Nos. 1/2, pp. 46-47 Taf.6, Figs. 4-6, Taf.7; Figs. 1-2, Abb.2;-

Description: The small trochoid test is sub-circular, almost as long as broad, unequally biconvex with the dorsal side being more so. On the dorsal side, about 3-3&1/2 whorls are visible whereas on the ventral side only the last formed whorl is seen. On the dorsal side, the sub-rectangular chambers are higher than broader, gradually increase in size and appear inflated. On the ventral side all the 9-10 chambers of the last whorl are sub-triangular with their pointed ends projected towards the umbilicus. They are slightly inflated and gradually increase in size. The distinct sutures on the dorsal side are limbate, arcuate and slightly raised whereas ventrally, they are radial and depressed. The large umbilical area on the ventral side is shallow and filled with many granules of shell material. The thin calcareous wall is finely perforated. The rounded periphery is slightly lobulate. A narrow slit-like apperture occurs at the base of the subtriangular apertural face of the last formed chamber on the ventral side.

Remarks: This is one of the rare species in the Rameswaram sample. Seibold (1971,72) reported Ammonia sobrina from the coastal and lagoonal regions of Cochin area. This may be the first report of this species from any part of the East Coast of India.

Hypotypn: Length 0.45 m.m., width 0.39 m.m., thickness 0.25 m.m. AMKSD Cat. No. MF-221.

Genus ASTEROROTALIA Hofker, 1950

Asterorotalia trispinosa (Thalmann)

Pl.3, Figs. 23 a,b.

Rotalia pulchella (d' Orbigny), Brady, 1884, Rept. Voy, Challenger Zool. Vol. 9, S. 710, Taf. cxy. Figs. 8 a-b.

Rotalia trispinosa Thalman, 1933, Ecologae, Geol. Helv. Lausanne, Vol. 26, No.2, pp. 248-250, Pl.12.

Asterorotalia trispinosa (Thalmann) Bhatia and Bhalla, 1959, Jour. Paleont. Soc. India, Vol.4, p. 80, Pl.1, Figs. 10 a,b; - Ghose, 1966, Contr. Cushaman Found. Foram. Res. Vol. XVII pt.3, pp. 104 - 108, Figs 5 & 6; - Bhalla, 1968, No.I.S.I., No.38, pp. 382-385, Pl.2. Figs. 1 a,b.

Description: The small trochoid test is triangular, dorsiventrally compressed and almost equally biconvex.and On the dorsal side, the inflated sub-rectangular chambers are slightly higher than broader and gradually increase in size, whereas on the ventral side, all the 9-10 chambers of the exposed final whorl are sub-triangular with their pointed ends projected towards the umbilicus. On the dorsal side, the distinct limbate sutures are straight and slightly raised whereas on the ventral side they are almost radial to slightly oblique, limbate and depressed. The umbilical region on the ventral side is filled with a single solid plug of shell material. The calcareous, smooth and finely perforate wall is characterised by the presence

of three short and blunt spines which emerge from the three corners of the test. The acutely rounded periphery is lobulate. A slit-like aperture occurs at the base of the last formed chamber.

Remarks: In both the specimens of Asterorotalia trispinosa encountered from the beach samples of Rameswaram, the three spines are broken. According to Brady, H.B.(1884) these spines have their origin in the septal bands of the earlier convolutions and are formed nearly at equidistant peripheral radii.

The reported occurrences of this species from various Indian localities include those of Ganapati and Satyavati (1958), Bhatia and Bhalla (1959), Ghose (1966) & Bhalla(1968).

Hypotype: Length 0.50 m.m., breadth 0.47 m.m., thickness 0.15 m.m., AMUGD Cat. No. MF-222.

Genus PARAROTALIA Le Calvez, 1949

Pararotalia nipponica (Asano)

Pl.4, Figs. 24 a-c.

Rotalia nipponica Asano, 1936. Geol. Soc. Japan Jour. Vol.43 No.515, p. 614, Pl.31, Figs. 2 a-c.

Pararotalia nipponica (Asano) Ujiie, 1966, Paleont. Soc. Japan Trans. Proc, New Series No.61, pp. 191-200, Pls.24, 25;- Bhalla, 1970, Contr. Cushman Found. Foram. Res. Vol.21, pt.4. p. 188, Pl.20, Figs. 6 a-c.

Description: The small suboval test is slightly longer than broadth & unequally biconvex. The dorsal side is slightly more convex than the ventral one and consists of about 2&1/2 to 3 whorls. On this side, the chambers of all the whorls are visible externally and they are subrectangular, broader than high in earlier whorls and become higher than broad in the last few whorls. On the ventral side the 8-9 subtriangular chambers with their pointed ends projected towards umbilicus are visible externally and slightly inflated. Dorsally, the arcuate sutures are almost flush with the surface whereas on the ventral side they are arcuate and depressed. The umbilical region is covered partially with a solid plug of shell material. The calcareous wall is finely perforate. The broadly rounded periphery is lobulate and has a thin keel. The small slit-like aperture occurs at the base of the subtriangular apertural face in between the

periphery and umbilicus.

Remarks: Pararotalia nipponica is one of the abundantly occurring species in the study area with a variety of test shape and size. A comparison of the specimen with that of the beach sands of Madras (Bhalla, 1970) reveals that both are the same.

The observations on taxonomic status of P. nipponica (Asano) and allied species by Bhalla (1972) reveals that P. nipponica is valid whereas P. taiwanica and P. ozawi may be its junior synonyms.

Hypotypes: Length 0.77 m.m., breadth 0.70 m.m., thickness 0.35 m.m. AMUGD Cat. No. MP-223.

Genus PSEUDOROTALIA Reiss and Merling, 1958

Pseudorotalia schroeteriana (Parker and Jones)

Pl.4, Fig.25

Rotalia schroeteriana Parker and Jones in Carpenter, 1862, Intr. Foram, London. Roy. Soc. p. 213 Pl.13, Figs. 6-7; - Brady, 1884, Rept. Voy. Challenger Zool. Vol.9, pp. 707-708 Pl.115, Figs. 7 a-c.

Pseudorotalia schroeteriana (Parker and Jones), Bhalla, 1968, N.I.S.I. Bull. No.38, p. 384, Pl.2, Fig.2; - Ragothaman, 1974, Doctorate thesis (unpublished) pp. 98-100 Pl.9, Figs 1,2.

Description: The medium sized and unequally biconvex trochoid test has a slightly convex dorsal side consisting of about 2 & 1/2 whorls and a conical ventral side. On the dorsal side the subrectangular and gradually increasing chambers of all the whorls are almost as high as broad and appear slightly inflated. On the ventral side, the exposed 9-10 chambers of the last whorl are much broader than high and subtriangular in shape with their pointed ends directed towards the umbilicus. The distinct sutures on both the dorsal and ventral sides are slightly limbate, raised and ornamented with a number of hyaline beeds. The spiral suture on the dorsal side is also raised. The calcareous perforate wall is smooth. The periphery is subacute. On the ventral side the elongate slit-like aperture occurs at the base of the apertural face of the last formed chamber.

Remarks: *Pseudorotalia schroeteriana* occurs rarely in the beach sands of Rameswaram. The conical shape and the beeded ornamentation of the sutures are the diagnostic characters of the species. This species is similar to the one reported earlier from the Vishakapatnam beach sands (Bhalla, 1968).

This is an Indo-Pacific species which is commonly found in shallow tropical waters (Bhalla, 1968).

Hypotype: Length 0.77 m.m. max. breadth 0.75, AMUGD Cat. No. MF-224.

Family	ELPHIDIDAE	Galloway, 1933
Subfamily	ELPHIDINAE	Galloway, 1933
Genus	ELPHIDIUM	De Montfort, 1808

Elphidium advenum (Cushman)

Pl.4, Figs. 26 a,b.

Polystomella subnodosa Munster Sp. Brady, 1884, Rep. Voy. Chall. Zool. Vol. 9, p. 734, Pl.110, Fig.1

Polystomella advena Cushman, 1922, Carnegie Inst. Washington Publ. 311. p. 56, pl. 9, Figs. 11,12.

Elphidium advena (Cushman) Bhatia, 1956a Contr. Cushman Found. Foram. Res. Vol.7, pt. 1, p. 20, Fig.9.

Elphidium advenum (Cushman) Sethulekshmi Amma, 1958, Cent. Res. Inst. Kerala, Univ. Bull.6, No.2, Ser. C, p.22, Pl.1, Fig.34;- Bhatia and Bhalla, 1959, Jour. Pal. Soc. India Vol.4 p.79, Pl.1, Fig. 9 a,b; - Rasheed, 1969-70 b Madras Univ. Jour. B Vol. 39 & 40, p. 91, Pl.3, Figs. 21-22.

Description: The equally biconvex planispiral test is slightly longer than broader, somewhat laterally compressed and involute with a large umbilical area on either sides of the test. The 18-19 arcuate chambers are broader than higher, thick and narrow near the centre, and become thin and broad towards the periphery. The depressed sutures are arcuate and marked by many retral processes. The periphery is sub-acute and carinate. The calcareous

subtransluscent wall is smooth and perforate. The aperture consists of small rounded openings occurring at the base of the large subtriangular apertural face.

Remarks: Elphidium advenum occurs rarely in the Rameswaram beach sands. The specimen of the said species is similar to the one described from Vishakapatnam beach sands (Bhalla, 1968).

This cosmopolitan species has been reported from many areas of Eastern and Western Coasts of India viz. Bhatia and Bhalla (1959) from Puri beach sands, Bhalla(1968) from Vishakapatnam beach sands, Bhatia (1956) from Juhu and Bombay, Sethulakshmi Amma (1958) from Travancore Coast, Rocha and Dalal (1964 a,b) from Mid Cogola and Simbor beaches.

Hypotype: Max. length 0.37 m.m., max. breadth 0.32 m.m., thickness 0.20 m.m. - AMUGD Cat. No. MF-225.

Elphidium crispum (Linne')

Pl.4, Figs. 27 a,b.

Nautilus crispus Linneaus, 1758, syst. Nat. Ed.10, Holmiae Suecia (Sweden) tome 1, p. 709, Pl.1, Figs.2d-f

Polystomella crispa Linne, Brady, 1884, Rep. Voy. Chall. Zool. Vol.9, p. 736, Pl.110, Figs. 6 - 7.

Elphidium crispum (Linne) Cushman and Grant, 1927. Sandiego Soc. Nat. Hist. Trans. Vol.5, No.6, p. 73, Pl.7, Figs. 3 a-b; Bhatia, 1956, Contr. Cushman Found. Res. Vol.7, pt. 1, p. 20, Pl.5, Fig.11; ~~Bhalla, 1968~~, Bhalla, 1968 Bull. N.I.S.I. No.38 Pl.1, Sec.2, p. 385, Pl.2, Figs. 4 a-b; - Rasheed 1969-70 b, Madras Univ. Jour. B., Vols. 39-40, p. 58, Pl.3, Figs. 25-26; - Rajasekar, 1981, pp. 59-61, Pl.5, Figs. 18-19.

Description: The small planispiral involute test is equally biconvex, laterally compressed and almost rounded. It has a prominent perforate umbo on either sides. In the final whorl there are about 17 - 19 subtriangular chambers. They are broader than higher, thick at the inner margins and become thin and broader towards periphery. The distinct sutures are acruate and raised, and ornamented with well developed ratral processes which increase in size towards the periphery. The calcareous wall is finely perforate. The subacute periphery is keeled. The aperture consists of a few small openings situated at the base of the small subtriangular apertural face.

Remarks: Elphidium crispum occurs rarely in the study area and the specimens are similar to those from the Vishakapatnam beach sands (Bhalla, 1968).

This cosmopolitidn species has been widely recorded from many shallow water regions throughout the world. The occurrences of this species in the Indian region are also innumerable among which include those mentioned by Bhatia (1956) from shore sands of Bombay Juhu and Chaupatty, Sethulekshmi Amma (1958) from Travancore Coast, Rocha and Jbaldo (1964 a) from West Coast of India, Bhalla (1968,70) from beach sands of Vishakapatnam and (Marina) Madras respectively, Jain and Bhatia (1978) from Mandvi, Rajasekar (1961) from off, Tuticorin etc.

Hypotype: Max. diameter 0.47 m.m., Max. thickness 0.25 m.m. AMUGD Cat. No. MF-226.

2.1.6. Superfamily ORBITOIDACEA Schwager, 1876

Family EPONIDIDAE Hofker, 1951

Genus EPONIDES De Montfort, 1808

Eponides repandus (Fichtel and Moll)

Pl.4, Figs.28 a-c.

Nautilus repandus Fichtel and Moll, 1803, Test. Micr. p.35, Pl.3, Fig. a,d.

Pulvinulina repanda Fichtel and Moll sp. Brady, 1884, Rep. Voy. Chall. Zool. Vol. 9, p. 684, Pl.104, Figs. 18 a-c.

Eponides repanda (Fichtel and Moll) Cushman, 1931, U.S. Nat. Mus. Bull. 104, pt. 8, Pl.10, Figs. 7 a-c.

Eponides repandus (Fichtel and Moll) Rasheed, 1969-70 c, Madras Univ. Jour. B, Vols. 39 & 40, p. 157, Pl.1, Figs. 20 - 21; - Kameswara Rao, 1971 b, Proc. Ind. Acad. Sci. Vol. LXXIII, No.4, Sec. B, p.160, Fig. 51.

Description: The small sub-circular trochoid test is biconvex and consists of about 2 - 2&1/2 whorls. On the dorsal side, chambers of all the whorls which are visible are arcuate & subrectangular and broader than higher. It gradually increases in size and appear slightly inflated. On the ventral side, the only 7 - 8 chambers of the last whorl are visible. They are subtriangular with their pointed ends projected towards the umbilical region. They gradually increase in size. The distinct limbate

sutures are raised and arcuate on the dorsal side but almost radial to slightly curved and raised on the ventral side. The subacute periphery is slightly carinate. The thick calcareous wall is perforate. On the ventral side the umbilicus is closed by a thick shell substance. The elongate slit-like aperture occurs at the base of the triangular apertural face of the last formed chamber.

Remarks: Sponides repandus occurs rarely in the beach sands of Rameswaram. This species has been reported from many places in India, for example Sethulekshmi Amma (1958) from Travancore Coast, Rorhe and Ubaldo (1964, a,b) from Diu, Gogola and Simbor and from Jampore and Baga beaches respectively. Kameswara Rao(1971 b) from the northeastern part of the Arabian sea.

This species could be differentiated from Poroeponides lateralis (Terquem) in having a stout and biconvex test in which pores in the apertural face on the ventral side are wanting.

Hypotype: Length 0.62 m.m., breadth 0.57 m.m., thickness 0.35 m.m. AMUGD Cat. No. MF-227.

Family AMPHISTEGINIDAE Cushman, 1927

Genus AMPHISTEGINA d' Orbingy, 1826

Amphistegina radiatus (Fichtel and Moll)

Pl.4, Figs. 29 a,b.

Nautilus radiatus (Fichtel and Moll, 1798, Test Micr. Vienna p. 58, Tab. 8, Figs. 9 b-d.

Amphistegina lessoni d' Orbigny Var. radiata Fichtel and Moll Cushman, 1921, U.S. Nat. Mus., Bull. 100, Vol. 4, p. 372

Amphistegina radiata (Fichtel and Moll), Sethulekshmi Amma, 1958, Bull. Cent. Res. Inst. Univ., Kerala Ser. C. Vol.6, No.1, p. 17, Pl. 1, Figs. 27.

Amphistegina radiatus (Fichtel and Moll) Rasheed, 1969-70 C Madras Univ. Jour. B, Vols. 39 & 40, pp. 171 - 172, Pl.7, Figs. 8 -9.

Description: The small circular and latelally much compressed test is planispiral and involute. The chambers are numerous. They are much boarder than higher, boader at the outer margin and pointed towards the inner margins. The distinct thin sutures are flush with the surface, almost straight but much arcuate near the periphery . In between the regular sutures, one or two discontinuous short lines are present. The rounded perphery is acutely angled. The thin calcareous wall is smooth and subtranslucent but the umbones and

the sutures are vitreous. The small slit-like aperture is ventral and occurs at the base of the end chamber.

Remarks: Amphistegina radiatus occurs commonly in the study area. The specimens are similar to those as reported from the Coral Sea Specimens South of Papua (Rasheed, 1969-70C). Rocha and Ubaldo (1964 a) obtained the same species from Diu, Gogola and Simbor beach, West Coast of India.

Hypotype: Max. diameter 0.57 m.m., thickness 0.25 m.m. AMUGD. Cat. No. MF-228.

Family CYMBALOPORIDAE Cushman, 1927

Genus CYMBALOPORETTA Cushman, 1928

Cymaloporetta bradyi (Cushman)

Pl. 4, Figs. 30 a-c

Cymbaloporа poeyi var. - Brady, 1884.

Rept. Voy. Chall. Zool. Vol.9, p. 637, Pl. 102, Figs. 14 a-c

Cymbaloporа poeyi (d' Orbigny) var. bradyi - Cushman, 1915.

U.S. Nat. Mus. Bull.71, pt.5, p.25, Pl.10, Fig.2, Pl.14, Fig.2.

Cymbaloporetta bradyi Cushman, 1931.

U.S. Nat. Mus. Bull. 104, pt.8, p. 85; - Todd, 1965, U.S. Nat. Mus. Bull. 161, pt. 4, p. 37, Pl.19, Figs. 1-4; - Rasheed, 1969-70 C, Madras Univ. Journ.B, Vols. 39 & 40, p. 166, Pl. 5, Figs. 14 - 15.

Description: The small, almost circular test has a convex dorsal side and almost a plane ventral side. The early chambers are arranged in a trochospiral manner whereas the latter ones in annular series. On the dorsal side almost rounded chambers are slightly inflated and alternating with those of the adjacent annuli. On the ventral side, about 10 - 11 chambers of the last whorl only are seen. They are subtriangular with their pointed ends projected towards the umbilical region, separated and channeled in between. On the dorsal side

the distinct sutures are slightly depressed whereas on the ventral side they are deeply depressed, limbate and radial. The rounded periphery is slightly lobulate. The calcareous wall is subtransparent, coarsely perforate and more so on dorsal side. On the ventral side two small slit-like apertures occur on either sides of each chamber.

Remarks: This species (Cymbaloporetta bradyi) is widespread in warm and shallow waters. It is rare in the present material.

Todd and Brounimann (1957) described this species from eastern Gulf of Paria. Todd (1965) made a detailed taxonomic study of this species from the Tropical Pacific and compared the same with C. squammosa. He showed differences in both the species. The speciman concerned is similar to the figure and description of Todd (1965).

From the Indian region this species has been reported by Rao and Rao (1976) from Chipurupalle stream, East Coast of India.

Hypotype: Length 0.55 m.m., width 0.54 m.m., height 0.20 m.m. AMUGD Cat. No. MF-229.

FIG. 2 - MAP SHOWING RAMESWARAM (PRESENT AREA) AND OTHER LOCALITIES OF COMPARISON IN THE EAST AND WEST COASTS OF INDIA

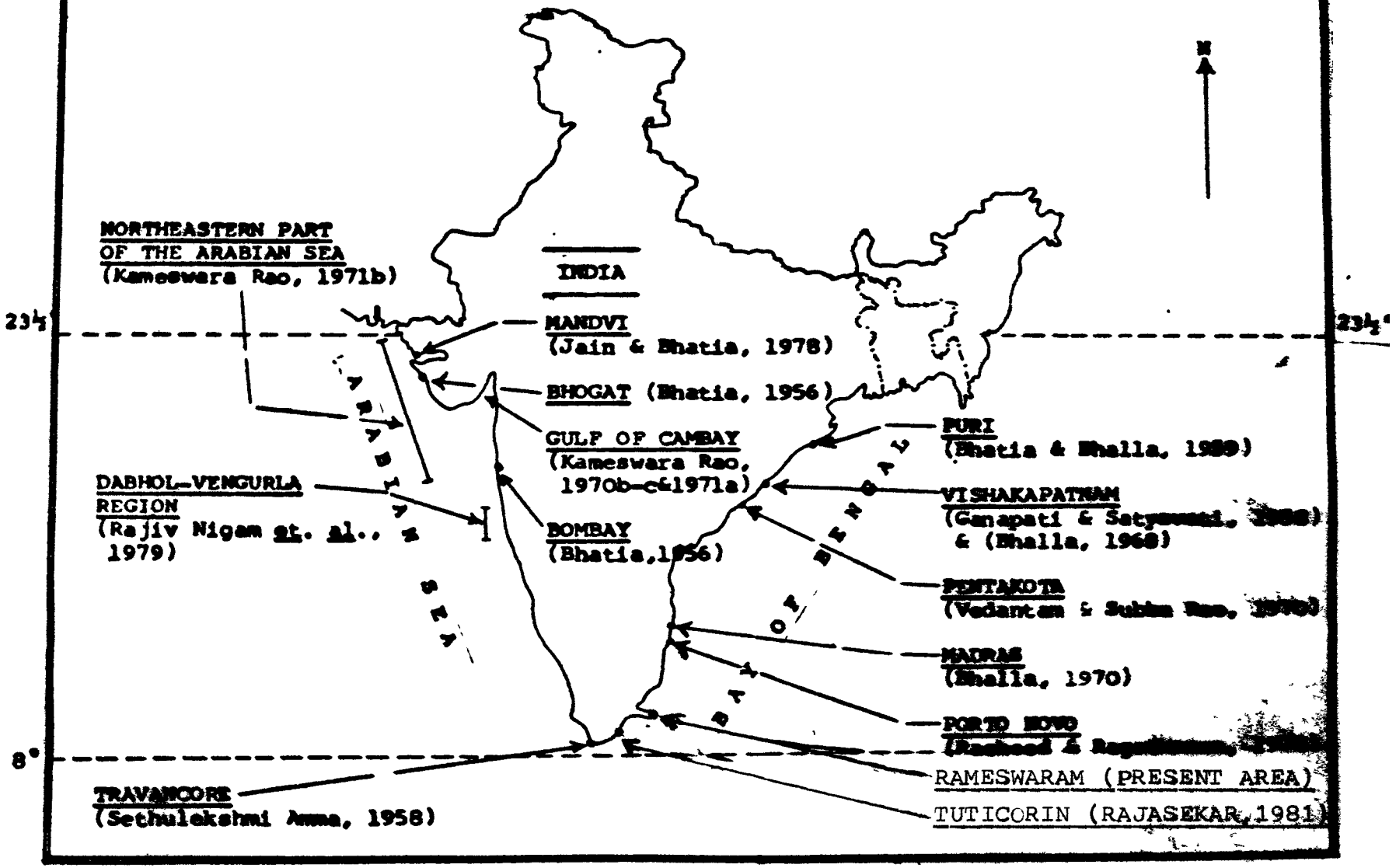


TABLE 1 - LIST OF VARIOUS LOCALITIES WITH WHICH RAMESWARAM FAUNA HAS BEEN COMPARED.

		AUTHOR AND YEAR		AREA
EAST COAST	NORTHEASTERN COAST	1. Bhatia, S.B. &Bhalla, S.N.	(1959)	Beach Sands at Puri
		2. Ganapati, P.N. & Satyavati, P.	(1958)	Bottom Sediments off Vishakapatnam
		3. Bhalla, S.N.	(1968)	Beach Sands of Vishakapatnam
		4. Vedantam, D.& Subba Rao, M.	(1970)	Sediments Off Pentakota
	SOUTHEASTERN COAST	5. Bhalla, S.N.	(1970)	Marina beach sands
		6. Rasheed, D.A. & Nagothaman, V.	(1978)	Sediments off porto Novo
		7. Rajangam, M.	(1981)	Sediments off Tuticorin
WEST COAST	NORTHWESTERN COAST	8. Kameswara Rao, K.	(1971b)	Northeastern part of the Arabian Sea.
		9. Jain, S.P.& Bhatia, S.B.	(1978)	Beach sands at Mandvi.
		10. Kameswara Rao, K. (1970b-c & 1971 a)		Gulf of Cambay.
		11. Bhatia, S.B.	(1956)	Shore Sands of Bombay and Bhogat.
		12. Rajiv Nigam, M.D. Mhunda Padmanabha Setty, M.V. Ambre.	(1979)	Innershelf of DabholVengurla Region.
	SOUTHWESTERN COAST	13. Sethulekshmi Amma, J.	(1958)	Travancore coast and backwaters.

Chapter - III

3. FORAMINIFERAL ASSEMBLAGE AND COMPARISON:

3.1. FORAMINIFERAL ASSEMBLAGE OF THE STUDY AREA:

The investigations carried out on the beach sand samples collected from Rameswaram reveals the occurrence of thirty foraminiferal species which are as follows:

1. Textularia conica d' Orbigny - - - - - - - - - - R
2. T. cf. T. gramen d' Orbigny - - - - - - - - - - R
3. T. pseudorugosa Lacroix - - - - - - - - - - R
4. Spiroloculina aequa Cushman - - - - - - - - - - R
5. S. ancillarum d' Orbigny - - - - - - - - - - R
6. S. communis Cushman and Todd - - - - - - - - - - F
7. Vertebralina striata d' Orbigny - - - - - - - - - R
8. Quinqueloculina curta Cushman - - - - - - - - - - R
9. Q. seminulum (Linne') - - - - - - - - - - R
10. Q. vulgaris d' Orbigny - - - - - - - - - - C
11. Q. sp. indet. - - - - - - - - - - R
12. Pateoris sp. indet. - - - - - - - - - - R
13. Triloculina insignis (Brady) - - - - - - - - - - C
14. T. Terquemiana (Brady) - - - - - - - - - - F
15. T. tricarinata d' Orbigny - - - - - - - - - - R
16. T. trigonula Lamarck - - - - - - - - - - R
17. Glandulina laevigata d' Orbigny - - - - - - - - - R
18. Rosalina floridana (Cushman) - - - - - - - - - - R

19. Glabratella sp. indet. - - - - - - - - - - - - - A

20. Ammonia annectens (Parker and Jones) - - - - - - - C

21. A. beccarii var. tepida (Cushman) - - - - - - - - R

22. A. sobrina (Shupack) - - - - - - - - - - - - - R

23. Asterorotalia trispinosa (Thalmann) - - - - - - - R

24. Pararotalia nipponica (Asano) - - - - - - - - - - A

25. Pseudorotalia schroeteriana (Parker and Jones) - R

26. Elphidium advenum (Cushman) - - - - - - - - - - R

27. E. crispum (Linne) - - - - - - - - - - - - - R

28. Eponides repandus (Fichtel and Moll) - - - - - - - R

29. Amphistegina radiatus (Fichtel and Moll) - - - - - C

30. Cymbaloporetta bradyi (Cushman) - - - - - - - - - R

R = 1-5 specimens, C = 6-10 specimens, F = 11-20 specimens

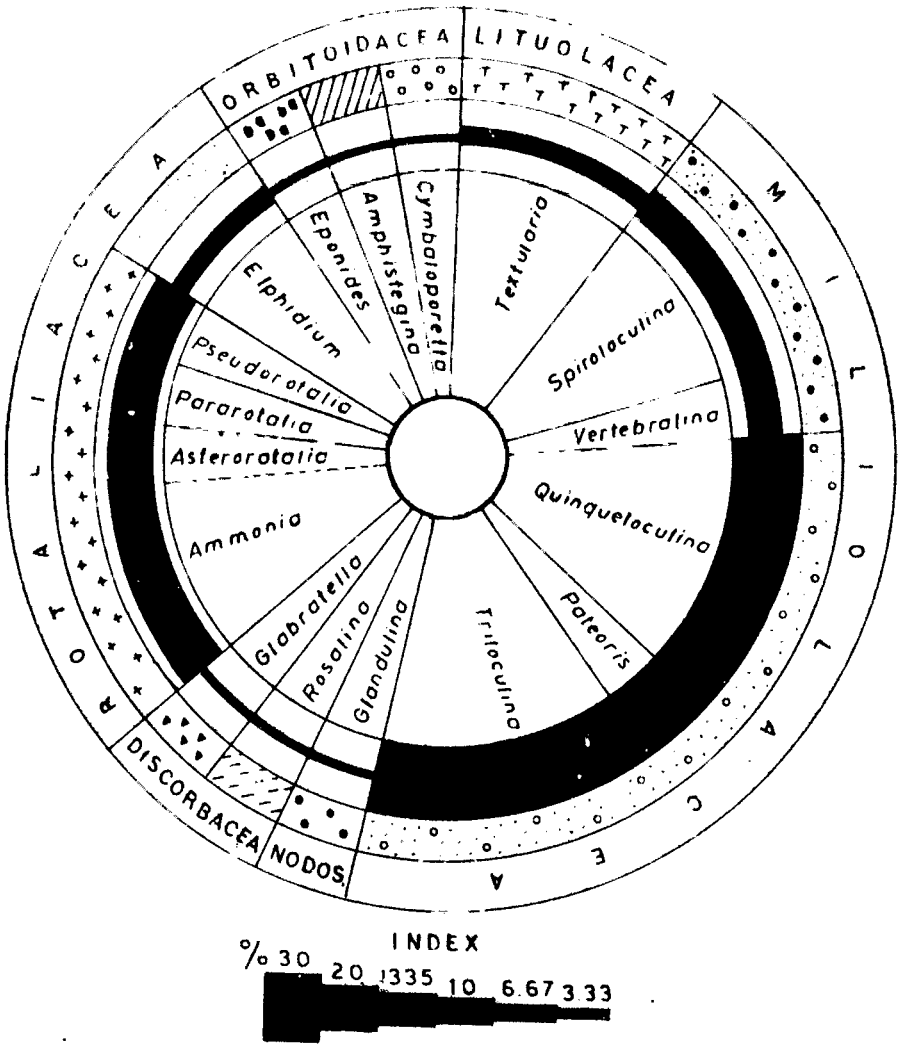
A = more than 20 specimens

R = Rare, C = Common, F = Frequent, A = Abundant

These thirty species belong to seventeen genera, eleven families, six superfamilies and three suborders.

Among the thirty species three are arenaceous foraminifera, thirteen are calcareous procellaneous, and the rest fourteen are calcareous perforate forms.

FIG 3



COMPOSITION OF FORAMINIFERAL ASSEMBLAGE

In the present area, out of the eleven families, family Miliolidae is best represented with 9 species. Of the remaining twentyone species, 6 belong to Rotaliidae, 4 to Nubeculariidae, 3 to Textulariidae, 2 to Elphididae and 1 each to Glandulinidae, Discorbidae, Glabratellidae, Eponididae, Amphisteginidae and Cymbaloporidae (~~Text~~ Fig.1).

Of the thirty species recorded from the study area Glabratella sp. indet. and Pararotalia nipponica have been found to occur abundantly; the four species namely Quinqueloculina vulgaris, Triloculina insignis, Ammonia annectens and Amphistegina radiatus are of common occurrence; the two species, Spiroloculina communis and Triloculina terquemina are frequent, whereas, the remaining twenty-two species occur rarely and they are as follows:
Textularia conica, T. cf. T. gramen. T. pseudorugosa., Spiroloculina aequa, S. antillarum, Vertebralina striata, Quinqueloculina curta, Q. seminulum, Q. sp. indet., Pateoris sp. indet., Triloculina tricarinata, T. trigonula, Glandulina laevigata, Rosalina floridana, Ammonia beccarii var. tenida, A. sobrina, Asterorotalia trispinosa, Pseudorotalia schroeteriana, Elphidum advenum, E. crispum, Eponides repandus, and Cymbaloporetta bradyi.

Textularia pseudorugosa, Pateoris sp. indet. and Glandulina laevigata are reported here for the first time from the Indian waters. However, Textularia pseudorugosa has been reported earlier from the Miocene sediments of Kathiawar.

TABLE - 2 - FORAMINIFERA OF THE PRESENT AREA AND THE SPECIES THAT ARE IN COMMON OCCURRENCE IN VARIOUS LOCALITIES OF COMPARISON

S.NO.	FORAMINIFERA FROM RAMESWARAM	OTHER AREAS COMPARED											
		EAST COAST						WEST COAST					
		Northern Part			Southern Part			Northern Part			Southern Part		
		1	2	3	4	5	6	7	8	9	10	11	12
1.	*** Ammonia annectens	x			x						x	x	
2.	** A. beccarii var. tepida			x		x	x						
3.	* A. sobrina												
4.	*** Amphistegina radiata			x							x	x	x
5.	** Asterotalia trispinosa	x	x	x		x							
6.	** Cymbaloporetta bradyi					x							
7.	*** Elphidium advenum	x	x					x	x		x	x	x
8.	*** Criscum		x	x	x	x	x		x	x	x	x	x
9.	**** Eponides repandus							x				x	x
10.	* Glabratella sp. indet												
11.	* Glandilina laevigata												
12.	** Pararotalia nipponica				x								
13.	* Pateroris sp. indet												
14.	** Pseudorotalia schroeteriana		x	x		x							
15.	* Quinqueloculina curta												
16.	*** Q. seminulum	x	x			x		x	x	x	x	x	
17.	*** Q. vulgaris		x	x	x			x		x		x	
18.	* Q. sp. indet												
19.	* Rosalina floridana												
20.	**** Spiroloculina aequa		x									x	x
21.	*** S. antillarum								x	x			
22.	*** S. communis	x	x			x	x					x	x
23.	*** Textularia conica					x	x	x			x	x	x
24.	* T.Ef. T. gramen												
25.	* T. pseudoruvosa												
26.	*** Triloculina insignis												
27.	*** T. terquemiana	x					x	x			x		x
28.	*** T. tricarinata	x	x		x		x	x		x	x	x	x
29.	*** T. trigonula	x	x	x	x		x	x	x	x	x		
30.	*** Vertebralina striata			x			x	x		x			x

X - Species present in the respective areas

* - Not recorded in any of the compared areas (i.e. present only in Rameswaram)

** - Occur in the East Coast only

*** - Occur in the East and West Coasts

**** - Occur in the West Coast only

INDEX

EAST COAST

1. Beach sands ar Puri
2. Vishakapatnam area
3. Sediments off Pentakota.
4. Marina beach sands
5. Sediments off Porto Novo
6. Sediments off Tuticorin

WEST COAST

7. Northeaster part of the Arabian sea.
8. Beach sands at Mandi.
9. Gulf of Cambay.
10. Shoresands of Bombay and Shogat.
11. The innershelf of Dabhol - Vengurla region.
12. Travancore coast and backwaters.

3.2. COMPARISON OF FORAMINIFERAL FAUNA:

The foraminiferal fauna of the study area has been compared with that reported from the beach and off-shore samples from various localities in the Eastern and Western Coasts of India (Fig.2).

3.2.1 COMPARISON OF THE FORAMINIFERAL FAUNA OF THE NORTHERN PART OF THE EAST COAST OF INDIA WITH THOSE OF THE SOUTHERN PART

The following 47 species which are found in the East Coast of India, are common in both the northern and southern parts of East Coast: Alveolinella quoyi, Ammonia beccarii, A. beccarii var. tepida, A. dentatus, Amphistegina lessoni, A. radiata, Asterorotalia trispinosa, Cancris oblonga, Cassidulina laevigata, Cibicides lobatulus, C. refulgens, Elphidium advenum, E. crispum, E. hispidulum, E. macellum E. simplex, Florilus grateloupi, E. scaphum, Globigerina bulloides, Globigerinoides ruber, G. sacculifer, G. trilobus, Globorotalia menardii, Hauerina involuta, Lagena perlucida, L. striata, Loxostomum lobatum, Nonion labradoricum, Operculina ammonoides, Planorbulina mediterranensis, Poroeponides lateralis, Pseudotriloculina rupertiana, Pseudorotalia schroeteriana, Quinqueloculina agglutinans, Q. bicostata, Q. lamarckiana, Q. seminulum, Q. vulgaris, Sorites marginalis, Spiroloculina antillarum, S. communis, Textularia agglutinans, Triloculina oblonga, T. terquemiana, T. tricarinata, T. trigonula, and Vertebralina striata.

Of the foraminifera reported fromvarious localities in the East Coast, one hundred and seventy-nine species are confined only to the northern part (i.e. beach sands at Puri, sediments off Vishakapatnam, beach sands of Vishakapatnam and the sediments off Pentakota). They are: Adelosina laevigata, Ammonia beccillosa A. aff. beccillosa, Angulogerina angulosa, Archaias angulatus, Articulina sagrai, Asterigerina sp., Bathysiphon rufescens, Biqueninq lodoensis, Biloculinella sp. indet. Bolivina compacta B. hantkeninq, B. increscens, B. robusta, B. seminuda, B. spathulata, B. spinea, B. vadescens, B. sp., Bulimina affinis, B. marginata, B. sp. indet., Buliminella elegantissima, Calcarina spengleri, Cassidella bradyi, Cibicides cicatricosus, C. margaritifer, C. sp. indet., Clavulinodes cf. aperturs, Cycloclypeus sp., Delosina sp., Dentalina communis, D. vertebralis albatrossi, Dentostomina agglutinans, Discorbinella montreyehsis, Discorbis australis, D. vesicularis, Elphidium craticulatum, E. discoidale, E. indicum E. cf. E. minutum, E. striato-punctatum, E. sp. indet., E. sp., Entzia tetrastomella, Epistomina elegans, Eponides tuberculatus, Flintina bradyana, Gaudryina rotunda, G. triangularis, G. triangularis angulata, Globigerina aequilateralis, G. conglomerata, G. eggeri, G. falconensis, G. hexagona, G. rubescens, Globigerinella aequilateralis, Globigerinita glutinata, G. uvula, Globigerinoides conglobatus, G. sp., Globulina gibba, Guttulina (Sigmoidina) pacifica, G. problema, Gyroidina soldani, Hanzawaia concentrica, Haplophragmoides canariensis, Heronallia wilsonia, Heterolepa dutemplei,

Heterostegina depressa, Hyperammina friabilis, Lagena tenuis, L. sp., Lagenamina laguncula, Lamarckiana arenacea, L. repeyensis, Lituola sp., Loxostomum convallarium, L. limbatum, Marsipella sp., Miliammina oblonga, Miliolinella subrotunda, Neoconorbina patelliformis, Nodosaria catesbyi, N. japonica, ~~catesbyi, N. japonca~~, N. milletia, N. pauciloculata, N. vertebralis, N. sp., Nonion incisum, N. pompiloides, N. transiucens, Operculina bartschi, O. bartihi/ var. ornata, O. complanata, O. granulosa, Orbulina universa, Operculinella sp. Ophthalmidium inconstens, O. sp., Palmerinella plamerae, Peneroplis pertusus, Planispirinella exigua, Planulina ornata, Polymorphina sp., Pseudoglandulina sp., Pullenietina obliqueloculata, Pyrgo elongata, P. sarsi, P. sp., Quinqueloculina cuvieriana, Q. candeina Q. curvieriana, Q. dutempiei, Q. aff. lamarckiana, Q. oblonga, Q. reticosa, Q. reticulata, Q. seguenzi, Q. schlumbergeri, Q. scheibersi, Q. tropicalis, Q. sp., Rosalina soldanii, Rhabdammina abyssorum, Rhizammina algaeformis, Robulus calcar, R. limbosus, R. macrodiscus, R. stephensoni, Rotalia calcar, R. trochidiformis, Saccammina sphaerica, Sagenaria (Cristellaria) tricarinella, Schlumbergerina alveoliniformis, Siemoilina tenuis, Sphaeroidinella dehiscens, Spirillina vivipara, Spiroloculina arenaria, S. clara, S. dispersalis, S. grateloupi, S. grateloupi var. incisa, S. indica, S. robusta, S. sp., Spirothalmidium acutimargo, Textularia candeiana, T. aff. canduinna, T. foliacea T. aff. Kerimbaensis, T. mayori, T. pseudocarinata.

S. quadrilatera, Triloculina aff. bicarinata, T. sp./ A_m T. sp./ B., T. sp. C., Trifarina bradyi, Trochammina inflata, Truncatulina mercuratifera, T. praecincta, Uvigerina ampullacea, U. peregrina, U. pigmea, U. proboscidea, Valvulina sp.

The following 79 species which are absent in the northern part, occur only in the southern part of the East Coast (i.e. Beach sands of Madras, Sediments off porto Novo, Rameswaram beach sands and sediments off Tuticorin): Ammobaculites dilatatus, A. aciguus, Amonia annectans, A. cf. A. beccarii, A. sobrina, Ammobaculina madagascariensis, Bolivina nobilis, B. pseudoplicata, B. simplex, B. striatula, Bulimina pilletti, Chrysalidinella dimorpha, Cymbaloporetta bradyi, Discorbis nitida, Eggerella sp., E. advena, Elphidium crispum, var. crassa, E. excavatum, E. incertum, E. pilletti, E. minutum, E. translucens, E. sp./ A_m E. sp./ B., Eponides repandus, Fissurina bodjonegoroensis, Florilus boueanum, Glabratella sp./ indet., Glandulina laevigata, Globigerina calida, Haplophragmoides emaciatum, Hauerina bradyi, H. fragilissima, Heterostegina suborbicularis, Miliammina fusca, Miliolinella circularis, Operculinella cumingii, O. venosus, Osangularia venusta, Pararotalia nipponica, Pateoris sp. indet., Peneroplis planatus, Planorbulinella larvata, Pseudomassilina decilenta, Pyrgo nakukava, P. subsphaerica, Quinqueloculina curta, Q. inca, Q. polygona, Q. pseudoreticulata, Q. cf. Q. seminulum, Q. undulose-costata, Q. sp. indet., Rectobolivina raphanus, Reophax

comprima, Reusella spinulosa, Rhabdammina scabra, R Rosalina floridana, R. globularis, Sigmavirgulina tortuosa, Siphogeneria glabra, S. virgula, Siphonina philipinensis, Spirolina arietinus, Spiroloculina aequa, S. costifera, S. nitida, S. orbis, Textularia aura, T. conica, T.foliacea var. occidentalis, T. cf. T. gramen, T. palustris, T. pseudorugosa, Triloculina insigmis, T. schrieberiana, Trochammina lobata, T. squamata, Uvigerina hispido-costata.

3.2.1.1. Beach Sands at Puri:

Out of the 14 species described from the beach sands of Puri, Orissa, (Bhatia and Bhalla, 1959), only five species namely, Asterorotalia trispinosa, Elphidium advenum, Quinqueloculina seminulum, Streblus annectens and Triloculina trigonula, occur in the study area also (Table-2).

Biloculinella sp. indet., Dentostomina agglutinans, Cibicides sp. indet., Elphidium simplex, E. sp. indet., Nonion scaphum, Poroeponides lateralis, Quinqueloculina tropicalis and streblus dentatus, which are present at Puri, are absent at Rameswaram.

3.2.1.2. Vishakapatnam area:

Of the foraminiferal species reported from the Vishakapatnam area (Ganapati and Satyavati, 1958-103 species; Bhalla, 1968-16 species), only the following 11 species are common to the Rameswaram area (Table-2):

Elphidium advenum, E. crispum, Pseudorotalia schroeteriana, Quinqueloculina seminulum, Q. vulgaris, Rotalia Pulchella, Spiroloculina antillarum, S. communis, Triloculina terquemiana, T. tricarinata and T. trigonula.

The rest of the species as reported by them (op. cit.), are absent in Rameswaram.

3.2.1.3. Sediments off Pentakota:

Out of one hundred and thirtyone species recorded from off Pentakota (Vedantam and Subba Rao, 1970), only the following ten are common to my area also: Ammonia beccarii var. tepida, Amphistegina radiata, Asterorotalia trispinosa, Elphidium crispum, Pseudorotalia schroeteriana, Quinqueloculina vulgaris, Spiroloculina communis, Triloculina tricarinata, T. trigonula and Vertebralina striata (Table-2). The rest one hundred and twentyone species are absent in the study area.

3.2.1.4. Marina beach Sands:

Of the fifteen species reported from the beach samples of Marina, Madras (Bhalla, 1970), Ammonia annectens, Elphidium crispum, Pararotalia nipponica, Quinqueloculina vulgaris and Triloculina trigonula have been encountered in the study area also (Table-2). The remaining ten species namely, Ammonia cf. A. hozanensis, Amphistegina madagascariensis

Elphidium minutum, E. sp. A, E. sp., E. Florilus scaphum, Glabratella sp. indet., Poroeponides lateralis, Quinqueloculina cf. Q. seminulum and Q. sp. indet., are not found.

3.2.1.5. Sediments off Porto Novo:

Of the seventy foraminiferal species recorded by Rasheed and Ragothaman (1978) from off Porto Novo, eleven species namely, Ammonia beccarii var. tepida, Asterorotalia pulchella, Cymbaloporetta bradyi, Elphidium crispum, Pseudorotalia schroeteriana, Quinqueloculina seminulum, Spiroloculina communis, Textularia conica, Triloculina tricarinata, T. trigonula and Vertebralina striata are also present in the study area (Table-2). The rest fiftynine species have not been found in the area.

3.2.1.6. Sediments Off Tuticorin

Out of the reported fiftynine species from off Tuticorin (Rajasekar, 1981), Ammonia beccarii var. tepida, Elphidium crispum, Spiroloculina communis, Textularia conica, Triloculina terquemiana, T. tricarinata, T. trigonula and Vertebralina striata occur in Rameswaram beach samples also (Table-2). The rest fifty-one species of that area are not found in the study area.

3.2.1.7. Summary of the comparison of Rameswaram fauna with those from localities of the East Coast of India.

Of the thirty species of foraminifera identified from the beach samples of Rameswaram, eighteen species have also been reported from other areas on the East Coast of India (Table-2). Out of this eighteen species, the following twelve occur both in the northern and southern parts of the East Coast of India: Ammonia annectens, A. beccarii var. tepida, Asterorotalia trispinosa, Elphidium crispum, Pseudorotalia schroeteriana, Quinqueloculina seminulum, Q. vulgaris, Spiroloculina communis, Triloculina terquemiana, T. tricarinata, T. trigonula and Vertebralina striata.

Three species, viz. Amphistegina radiata, Elphidium advenum and Spiroloculina antillarum which are reported from the northern part of the East Coast, are absent in the southern part.

The rest three species, namely, Cymbaloporetta bradyi, Pararotalia nipponica and Textularia conica are found in the southern part only.

Along the East Coast of Indian only Rameswaram has the following twelve species: Ammonia sobrina, Sponides repandus, Glabratella sp. indet., Glandulina laevigata, Patellina sp. indet., Quinqueloculina curta, Q.

sp. indet., Rosalina floridana, Spiroloculina aequa, Textularia cf. T. crassa, T. pseudorugosa and Triloculina insignis.

3.2.2. A general Comparison between the Foraminiferal Fauna of the East and the West Coasts of India.

The following ninety-five foraminiferal species are common to both the East and West Coasts of India: Ammobaculites dilatatus, Ammonia annectens, A. beccarii, A. dentata, A. papillosa, Amphistegina radiata, Bolivina hantkenina, B. nobilis, B. striatula B. valescens, Bulimina marginata, Buliminella elegantissima, Chrysalidinella dimorpha, Cibicides lobatulus, C. refulgens, Cymbaloporetta bradyi, Discorbis nitida, Elphidium advenum, E. craticulatum, E. crispum, E. excavatum, E. hispidulum, E. indicum, E. minutum, E. simplex, E. striato-punctatum, Eponides repandus, Florilus bouesanum, Globigerina bulloides, G. calida, Globigerinella aequilateralis, Globigerinoides conglobatus, G. ruber, G. sacculifer, Globorotalia menardii, Hauerina fragilissima H. involuta, Lagena perlucida, L. striata, Lenticulina limbatum, L. lobatum, Neoconorbina patelliformis, Nodosaria vertebralis, Nonion grateloupi, N. pompiloides, N. scaphum, Operculina granulosa, Operculinella cumingii, Orbulina universa, Palmerinella palmerae, Peneroplis pertusus, Planorbulina mediterranensis,

Planorbulinella larvata, Planulina ornata, Porgponides lateralis, Pyrgo subsphaerica, Quinqueloculina agglutinans, Q. candeina, Q. lamarckiana, Q. reticulata, Q. seminulum Q. undulato-costata, Q. vulgaris, Recto bolivina raphanus, Reusella spinosa, Rhabdammina abyssorum, Robulus calcar, R. limbosus, Rosalina globularis, Rotalia calcar, Sigmavirgulina tortuosa, Spiroplectinella carinata, Spirillina vivipara, S. pirotoculana sequa, S. antillarum, S. Communis, S. orateloupi, S. indica, Spiroplectammina biformis, Spirothalmidium acutimargo, Textularia agglutinans, T. conica, T. candeiana, T. foliacea, T. pseudocarinata, Triloculina insignis, T. oblonga, T. terquemiana, T. tricarinata, Trochammina inflata, Uvigerina ampullacea, U. proboscidea, and Vertebralina striata.

The following two hundred and one species recorded from various localities from the East Coast of India (Fig. 2) have not been reported from any of the localities on the West Coast: Adelosina laevigata, Alveolinella quoyi, Ammobaculites exiguus, Ammonia beccarii var. tepida, A. cf. A. heterostegina papillosa, A. sobrina, Amphistegina lessoni, A. madagariensis, Angulogerina angulosa, Archaias angulatus, Articulina sagrii, Asterogerina sp., Asterorotalia trispinosa, Bathysiphon rufescens, Bigenerina nodosaria, Biloculinella sp. indet., Bolivina compacta, B. incrassata, B. pseudoplicata, B. robusta, B. seminula, B. simplex, B. spathulata, B. spinea, B. sp., Bulimina affinis, B. sp. indet., Bulimonella milletti, Calcarina spengleri, Cancris oblonga, Cassidella

bradyi, Cassidulina laevigata, Gibicides cicatricosus, C. margaritifer, C. sp. indet., Clavulinoides cf. aperturus, Cyclolyrous sp., Dolosina sp., Dentalina communis, D. vertebrlis albatrossi, Dentastomina agglutinans, Discorbinella monterreyensis, Discorbisaustralis, D. vesicularis, Eggerella sp., E. advena, Elphidium crispium var. crassa, E. discoidale, E. excavatum, E. macellum, E. milletti, E. cf. E. minutum, E. translucens, E. sp. indet, E. sp., E. sp. a, E. sp., E, Entzia tetrastomella, Epistomina elegans, Eponides subornatus, Fissurina bodjonegoroensis, Flintina/ bradyana, Gaudryina robusta, G. triangularis, G. triangularis angulata, Glabratella sp. indet., Glandulina laevigata, Globigerina aequilateralis, G. conglomerata, G. eggeri, G. falconensis, G. hexagona, G. rubescens, Globigerinita glutinata, G. uvula, Globigerinoides trilobus, G. sp., Globulina gibbla, Guttulina (Sigmoidina) pacifica, G. Problema, Gyroidina soldani, Hanzawai concentrica, Haplophragmoides canariensis, H. emaciatum, Hauerina bradyi, Heronallia wilsoni, Heterolepa dutemplei, Heterostegina depressa, H. suborbicularis, Hyperammina friabilis, Lagena tenuis, L. sp., Lagenammina laguncula, Lamarckiana arenacea, L. replevensis, Lituola sp. Loxostomum convallarium, Marsipella sp., Massilina sp. Miliammina fusca, M. oblonga, Miliolinella circularis, M. subrotunda, Nodosaria catesbyi, N. japonica, N. milletti, N. pauciloculata, N. sp., Nonion inciusa, N. translucens, Operculina ammonoides, O. bartschi var. ornata, O. complanata, Operculinella venosum, O. sp.,

Opthalmidium inconstans, O. sp., Osangularia venusta, Pararotalia nipponica, Pateoris sp., indet., Peneroplis planatus, Planispirinella exigua, Polymorphina sp., Pseudoglandulina sp., Pseudorotalia schroeteriana, Pseudomassilina macilenta, Pseudotriloculina rupertiana, Pulleniatiana obliquiloculata, Pyrgo elongata, P. natukawa, P. sarsi, P. sp., Quinqueloculina auberiana, Q. bicostata, Q. curta, Q. cuWieriana, Q. dutemplei, Q. aff. lamarckiana, Q. oblonga, Q. polygona, Q. pseudoreticulata Q. reticosa, Q. reticulata Q. sacrai, Q. schlumbergeri, Q. scheibersi, Q. cf. Q. seminulum, Q. tropicalis, Q. sp., Q. sp. indet., Reophex comprima, Reusella aculeata, Rhabdammina scabra, Rhizammina algaeformis, Robulus macrodiscus, R. stephensoni, Rosalina floridana, Rotalia trochidiformis, Saccammina sphaerica, Saracenaria (Critellaria) tricorinella, Schlumbergerina alveoliniformis Sigmoilina tenuis, Siphogenerina glabra, Siphonina Philipinensis, Sphaeroidinella dehiscens, Spiroloculina arenaria, S. clara, S. costifera, S. disparilis, S. grateloupi var. incisa, S. nitida, S. orbis, S. robusta, S. sp., Spirolina arietinus, Textularia aura, T. aff. candeiana, T. foliacea var. occidentalis, T. cf. T. gramen, T. aff. Kerimbaensis, T. mayori, T. palustris, T. pseudorugosa, T. pseudotrochus, T. quadrilatera T. aff. bicarinata, T. schrieberiana, T. sp., A. T. sp. B., T. sp. C. Triforina bradyi, Trochammina lobata, T. squamata Truncatulina margaritifera, T. praecincta, Uvigerina hispidocostata, U. peregrina, U. pigmea and Vaginulina sp.

The following one hundred and seventy five species that were reported from various localities from the West Coast of India (Fig.2) have not been found from any of the localities on the East Coast: Ammobaculites agglutinans, Ammomasilina alveoliniformis, Anomalina balthica, A. ammonoides, A. coronata, A. grasserugosa, Anomalinella rostrata, Bigenerina cylindrica, Biloculina lucernula, Bolivina aenariensis, B. attica, B.beyrichi, B. capitata B. goesii, B. lanceolata, B. nitida, B. cf. pseudoplicata, B. punctata, B. rhomobidalis, B. cf. B. translucens, B. variabilis, Bolivinella margaritacea, Bulimina exilis, B. maraginata bigerialis, Cancris auricula, C. sagra, Cibicides basiloba, C. deprimus, C. kullenbergi, C. pseudoungeriana, C. sp. indet. Cornspira involvens, C. planorbis, Cornispiroides compressa, C. foliaceus, Cyclammina cancellata, Diffusilina humilis, Discorbis allomorphinoides, D. auriculana, D. bertholoti, D. mamilla, D. milletti, D. opercularis, D. orbicularis, D. parisiensis, D. vilardeboana, D. sp., indet., Eggerella advena, E. bradyi, Elphidium cf. craticulatum, E. discoidale multiloculum, E. fulunicum, E. jenseni, E. oceanicum, E. reticulosum, E. sp. indet. Eponides cf. parsecinctus, Fissurina marginata, Florilus asterizans, Fursenkoina pontoni, Globigerina dubia, G. inflata, Globoquadrina duterteri, Globorotalia tumida, Guttulina sp. A, G. sp. B. Haplophragmoides inflata, Lagena costata, L. cf.

costata var. amphora, L. globosa, L. gracilis, L. gracillima, L. hexagona, L. laevis, L. laevis variant, L. lagenoides, L. marginata, L. marginato-perforata, L. orbignyana, L. punctulata, L. quadrata, L. semistriata, L. striata var. strumosa, L. sulcata, L. trigono-marginata, L. wrightiana, Lamarckiana ventricosa, Loxostoma porrectum, L. rostrum, Massilina secans, M. secans, M. secans tropicalis, M. sp. indet. Melonis sp. indet. Miliolinella cf. labiosa, Neoconorbina terquemi, Nodosaria calomorpha, N. perversa, N. radicula, N. roemeri, N. subperversa, N. depressula, N. elongatum, N. granosum, N. pacificum, N. perforatum, Nonionella auricula, N. auris, N. basispinatus, N. cf. N. translucens, N. turgida, Operculina gaimardi, Parrotalia boltovskoyi, Planulina ariminensis, P. wullerstorfi, Pseudoeponides, equatoriana, Pulvinulina concamerata, P. haueri, P. oblonga, P. punctulata, Quinqueloculina bicornis, Q. bosciana, Q. crassa var. subcuneata, Q. (Miliola) karrebatica, Q. cf. mosharrafiai, Q. subcuneata, Q. venusta, Reussella pacifica, Robulus reniformis, R. sp. indet. Rotalia venusta, Rotorbinella sp., indet. Spiroloculina antillarum var. aequa, S. corrugata, S. depressa, S. depressa var. rotundata, S. excavata, S. eximia, S. planulata, Spirolina acicularis, Spirilline limbata, S. limbata var. denticulata, S. aff. audoicini, S. beccarii var. koeneenis, Textularia agglutinans var. fistulosa, T. concava, T. cuneiformis, T. cuneiformis var. fistulosa, T. gramen, T. iugosa, T. sagittula var. striata, T. semialata, T. stricta, T. circularis, T. cuneata, T. echinata, T. sp. cf. rotunda, T. aff. rupertiana,

T. linnaeana, T. tricarinata var. costata, T. sp. A. T. sp. B, T.sp. indet, Trifaxia lepida, Tubinella funalis funalis var. inornata, Uvigerina canariensis, U. porrecta, U. senticosa, U. tenuistriata, Vertebralina sp. indet., Virgulina concava, V. pauciloculata, V. squamosa and Virgulinella pertusa.

3.2.3. A general Comparison of Foraminiferal Fauna between the Northern and the Southern Parts of the West Coast of India

On the West Coast of India the following sixty-five species are of common occurrence in the northern and southern parts of the West Coast of India: Ammonia beccarii, Amphistegina radiata, Angulinella rostrata, Bigenerina cylindrica, Bolivina nobilis, Buliminina marginata, Chrysalidinella dimorpha, Cibicides pseudoungeriana, Discorbis globularis, D. nitida, D. Rosacea, D. villardeboana, Eggerella bradyi, Elphidium advena, E. crispum, E. striato-punctatum, Eponides repandus, Florilus boueanum, Globigerina bulloides, G. dubia, Globigerinella aequilateralis, Globigerinoides sacculifer, Globorotalia menardii, Haueinina fragilissima, Lagena globosa, L. hexagona, L. laevis, L. marginata, L. marginato-perforata, L. orbignyana, L. perlucida, L. punctulata, L. quadrata, L. semistriata, L. striata, Nodosaria radicula, Operculina granulosa, Orbulina universa, Planorbulinella larvata, Planulina wullerstorfi, Pseudorriloculina rupertiana, Quinqueloculina boueana, Q. vulgaris, Rhabdammina abyssorum, Rotalia Calcar, Sphaeroidina bulloides, Spiroloculina antillarum,

S. depressa, S. excavata, Spirillina limbata, S. vivipara, T. Textularia agglutinans, T. conica, T. foliacea, T. sagittula var. strata, T. stricta, Trioloculina circularis, T. linnaeana T. oblonga, T. terquemiana, T. tricarinata, Trochammina inflata, Tubipella funalis var. ipornata, Vertebralina striata and Virgulina squamosa.

Out of the total foraminiferal species reported from various localities from the West Coast of India (Fig. 2), the following one hundred and fifty-seven species are confined only to the northern part (i.e. Northern part of the Arabian Sea, Beach sands at Mandvi, Gulf of Cambay, Bombay and Bhogat beach sands and the inner shelf of Kathiawar region): Ammobaculites agglutinans, A. dilatatus, Anomalinella alveoliniformis, Anomalina anomeans, A. bavillensis, Anomalina ammonoides, A. coronata, Asterorotalia dentata, Biloculina lucernula, Bolivina costariensis, B. arcuata, B. capitata, B. goesii, B. hantkeniana, B. lanceolata, B. latidorsata, B. cf. pseudoplicata, B. punctata, B. rhomboidalis, B. striatula, Bolivina cf. B. translucens, B. vadescens, B. variabilis, B. sp. indet., Bolivinella margaritacea, Buliminaexilis, B. marginata biserialis, Cancris auricula C. sagra, Cibicides basiloba, C. deprimus, C. kullenbergi, C. lobatulus, C. refulgens, C. sp. indet., Cornuspira involvens, C. planorbis, Cornuspiroides foliaceus, Discorbis aurasena, D. berthelotti, D. sp. indet., Eggerella advena,

Elphidium craticulatum, E. cf. craticulatum, E. discoidale cultiloculum, E. excavatum, E. falunicum, E. hispidulum, E. indicum, E. jenseni, E. minutum, E. Oceanicum, E. simplex, E. sp. indet., Eponides cf. praecinctus, Fissurina marginata, Florilus asterizans, F. grateloupi, F. scaphum, Fursenkoina pontoni, Globigerina calida, Globigerinoides ruber, Globoquadrvina dutertrei, Globorotalia tumida, Guttulina sp. A. G. sp. B, Lagena costata, L. cf. costata var. amphora, L. gracilis, L. gracillima, L. laevis variant, L. lagenoides, L. sulcata, Lamarckiana ventricosa, Loxostoma limbatum, L. rostrum, Massilina secans tropicalis, M. sp. indet., Melonis sp. indet., Miliolinella cf. labiosa, Neoconorbina terquemi, Nodosaria calomorpha, N. perversa, N. roemeri, N. subperversa, Nonion depressulum, N. elongatum, N. granosum, N. pacificum, N. perforatum, N. pompioides, Nonionella auricula, N. auris, N. basispinatus, N. cf. N. translucens, N. turgida, Operculina gaimairdi Palmerinella palmerae, Pararotalia boltovskoyi, Planulina ornata, Porosponides lateralis, Pseudoponides equatoriana, Pulvinulina concamerata, P. oblonga, P. punctulata, Pyrgo subsphaerica, Quinqueloculina candeiana, Q. crassa var. subcuneata, Q. (Miliola) Kerimbatica, Q. lamarckiana, Q. mosharrafai, Q. reticulata, Q. seminulum, Q. subcuneata, Q. undulcso-costata, Q. venusta, Q. venusta, Rectobolivina raphanus, Reussella pacifica, Robulus calcar, R. limbosus,

R. reniformis, R. sp. indet., Rotalia venusta, Roterbinella sp. indet., Spiroloculina aequa, S. antillarum var. aequa, S. communis, S. corrugata, S. depressa var. subrotundata, S. eximia, S. grateloupi, S. indica, S. planulata, Spiroplectammina scutimargo, Streblus aff. auduni, S. beccarii var. koembergensis, Textularia candeiana, T. cuneiformis var. fistulosa, T. pseudo-carinata, T. semialata, Triloculina cuneata, T. echinata, T. sp. cf. rotunda, T. aff. rupertiana, T. trigonula, T. sp. A, T. sp. B, T. sp. indet., Uvigerina ampullacea, U. proboscidea, U. senticosa, U. tenuistriata, Vertebralina sp. indet., Virgulina concava, V. pauciloculata, and Virgulinella pertusa.

On the other hand the following forty-nine species are characteristically confined to the southern part only of the West Coast (Travancore Coast and Back waters): Anomalina balthica, A. grasserugosa, Bolivina beyrichi, B. tortuosa, Bulimipella elegantissima, Cornuspiroides compressa, Cyclammina cancellata, Cymbalooretta squamosa, Diffusilina humilis, Discorbis allomorphinoides, D. mamilla, D. milletti, D. opercularis, D. orbicularis, D. patelliformis, D. parisiensis, Elphidium reticulosum, Globigerina inflata, Globigerinoides conglobata, Haplophragmoides inflata, Haurina ornatissima, Lagena striata var. strumosa, L. trigono-marginata, L.

wrightiana, Lenticulina lobatum, L. porrectum, Marsilina secans, Nodosaria vertebralis, Operculinella cumingii, Peneroplis pertusus, Planorbulina mediterranensis, Planulina ariminensis, Pulvinulina haueri, Quinqueloculina agglutinans, Q. bicornis, Reussella spinulosa, Siphogenerina virgula, Spirillina limbata var. denticulata Spirolina acicularis, Textularia agglutinans var. fistulosa T. concava, T. conciformis, T. crassa, T. lucasa, Triloculina insignis, T. tricarinata var. costata, Tritaxia lapida, Uvigerina canariensis, and U. porrecta.

3.2.3.1. Northeastern part of the Arabian Sea:

Out of the ninety-two foraminiferal species recovered from the northern part of the Arabian Sea (Kameswara Rao, 1971 b), only the following eight species (Table-2) are found to be occurring in the study area: Elphidium advenum, Spondies repandus, Quinqueloculina seminulum, Q. vulgaris, Textularia concava, Triloculina tercuensiana, T. Tricarinata and T. trigonula.

3.2.3.2. Beach sands of Mandvi:

Out of the thirty-seven benthonic foraminifera reported from the beach sands of Mandvi, Kutch (Nain and Bhatia, 1978), only five species, viz: Elphidium advenum,

E. crispum, Quinqueloculina seminulum, Spiroloculina aequa and Vertebralina striata are found at Rameswaram (Table-2).

3.2.3.3. Gulf of Cambay:

Of the total eighty-four species of foraminifera identified from the Gulf of Cambay (Kameswara Rao, 1970 b-c and 1971 a), only six are present in the beach sands of Rameswaram (Table-2), they are: Elphidium crispum, Quinqueloculina seminulum, Q. vulgaris, Spiroloculina antillarum aequa, Triloculina tricarinata and T. trigonula.

3.2.3.4. Shore sands of Bombay and Bhogat:

Out of the forty-six species of foraminifera reported from the shore-sands of Juhu, Chaupatty and Bhogat (Bhatia, 1966[56]), only seven species namely, Elphidium advena, E. crispum, Quinqueloculina seminulum, Streblus annectens, Textularia conica, Triloculina terquemiana and T. tricarinata, are found at Rameswaram (Table-2).

According to Bhatia (1956) majority of the species were reported to be Indo-Pacific affinity, the rest being cosmopolitan. Also in the present area fauna of both the affinities are found to occur.

3.2.3.5. Inner shelf of Dabhol-Vengurla region:

Out of the sixty-five species reported by Nigam et al. (1979) only the following eleven species have been found to occur at Rameswaram: Ammonia annectens, Amphistegina radiata, Elphidium advenum, E. crispum, Eponides repandus, Quinqueloculina seminulum, Q. vulgaris, Spiroloculina antillarum, S. communis, Textularia conica, and Triloculina tricarinata (Table-2).

3.2.3.6. Travancore coast and backwaters:

Out of the one hundred and fourteen species of foraminifera, reported from the Travancore coast and backwaters of the Kerala State (Sethulekshmi Amma, 1958), only eleven species are occur in the study area. They are: Amphistegina radiata, Elphidium advenum, E. crispum, Eponides repandus, Quinqueloculina vulgaris, Spiroloculina antillarum, Textularia conica, Triloculina insignis, T. terquemiana, T. tricarinata, and Vertebralina striata

3.2.3.7. Summary of the comparison of Rameswaram fauna with those from various localities on the West Coast of India

Of the thirty species and varieties of foraminifera recorded from Rameswaram beach sands, sixteen have been

reported from various localities of the West Coast of India (Table-2).

Of these sixteen species, the following ten species are found to occur in both the northern and southern parts of the West Coast: Amphistegina radiata, Elphidium advenum, E. crispum, Epanides repandus, Quinqueloculina vulgaris, Spiroloculina antillarum, Textularia conica, Triloculina terquemiana, T. tricarinata and Vertebralina striata.

The five species namely Ammonia annectens, Quinqueloculina seminulum, Spiroloculina secua, S. communis and Triloculina trigonula that are found to occur in the northern part of the West Coast, are absent in the southern part.

Triloculina insignis is found to occur only in the southern part of the West Coast.

The following fourteen species that have been reported from the study area, were not found in any of the localities cited for comparison from the West Coast: Ammonia beccarii var. tepida, A. sobrina, Astrorotalia trispinosa, Cymbaloporatta bradyi, Globratella sp. indet., Glandulina laevigata, Pararotalia nipponica, Pateoris sp. indet., Pseudorotalia schroeteriana, Quinqueloculina curta, Q. sp. indet., Rosalina floridana, Textularia cf. T. crassa and T. pseudorugosa.

3.2.4. Summary of the Comparison of Rameswaram Fauna with those from the East and West Coasts of India.

A comparison of the Rameswaram fauna with those from the other localities both on the East and West Coasts of India (Table-1, Fig.2) reveals the following:

Out of the thirty species recorded from the present area, thirteen species occur both in East and West Coasts. They are: Ammonia annectens, Amphistegina radiata, Elphidium advenum, E. crispum, Quinqueloculina seminulum, Q. vulgaris, Spiroloculina antillarum, S. communis, Textularia conica, Triloculina tenuescens, T. tricarinata, T. trigonula and Vertebralina striata (Table-2).

The five species namely, Ammonia beccarii var. tepida, Asterorotalia trispinosa, Cymbalopporetta bradyi, Pararotalia nipponica and Pseudorotalia schroeteriana are found to occur on the East Coast of India only (Table-2).

The following three species of the present area namely, Eponides repandus, Spiroloculina aequa and Triloculina insignis occur only on the West Coast of India (Table-2).

The remaining nine species viz: Ammonia sobrina, Glabratella sp. indet., Glandulina laevigata, Patellina sp. indet., Quinqueloculina

Quinqueloculina curta, Q. sp. indet., Rosalina floridana, Textularia cf. T. crassa and Textularia pseudorugosa, recorded from the present area, are not found in any of the areas cited for comparison from the East as well as West Coasts.

3.3. CONCLUSION:

A comparative study of the foraminiferal fauna between two coasts of India and the Rameswaram beach, indicates that about twenty-one species are common on both the Indian coasts and that nine species are confined to Rameswaram only.

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EXPLANATION OF PLATE-1

1. Textularia conica d' Orbigny X 56
   1a, side view, 1b, apertural view.

2. Textularia cf. T. gramen d' Orbigny X 20
   2a, side view, 2b, apertural view.

3. Textularia pseudorugosa Lacroix X 24
   3a, side view, 3b, apertural view.

4. Spiroloculina aequa Cushman x 34
   4a, side view, 4b, apertural view.

5. Spiroloculina antillarum d' Orbigny x 30
   5a, side view, 5b, apertural view.

6. Spiroloculina communis Cushman and Todd x 26
   6a, side view, 6b, apertural view.

7. Vertebralina striata d' Orbigny x 46
   7a, b, opposite sides, 7c, apertural view.

8. Quinqueloculina curta Cushman x 32
   8a, b, opposite sides, 8c, apertural view.


PLATE - 1
1a
1b
2a
2b
3a
3b
4a
4b
5a
5b
6a
6b
7c
8c
7a
7b
8a
8b

EXPLANATION OF PLATE-2

9. Quinqueloculina seminulum (Linne') x 46
   9a,b, opposite sides, 9c apertural view.

10. Quinqueloculina vulgaris d' Orbigny x 46
    10a,b, opposite sides, 10c, apertural view.

11. Quinqueloculina sp. indet. x 52
    11 a,b, opposite sides, 11c, apertural view.

12. Pateoris sp. indet. x 50
    12a,b, opposite sides, 12c, apertural view.

13. Triloculina insignis (Brady) x 30
    13 a,b, opposite sides, 13c, apertural view.

14. Triloculina terquemana (Brady) x 30
    14a, side view, 14b, apertural view.

15. Triloculina tricarinata d' Orbigny x 40
    15a, side, view, 15b, apertural view.

16. Triloculina trigonula Lamarck x 36
    16a, side view, 16b, apertural view.

17. Glandulina laevigata d' Orbigny x 30

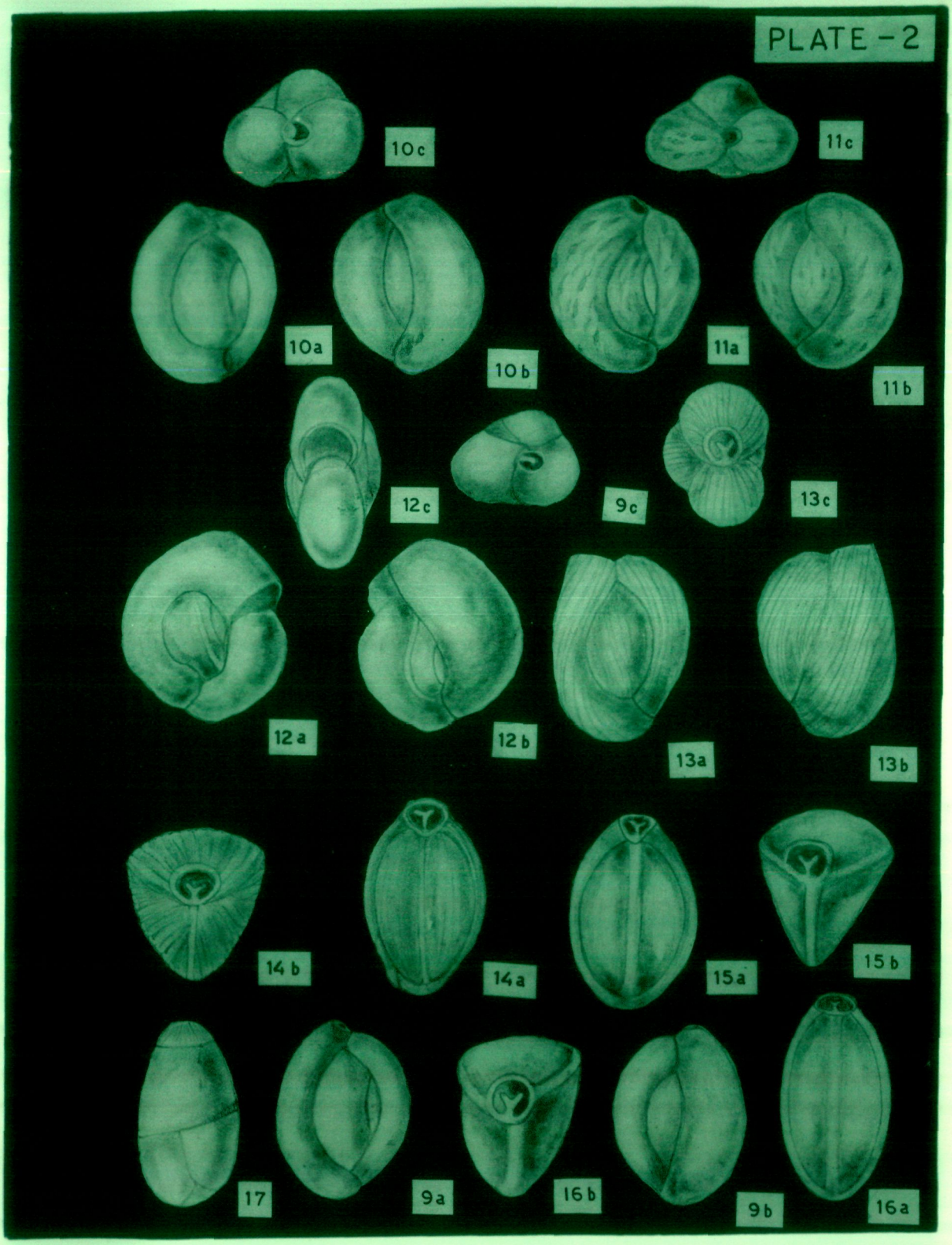
PLATE - 2
10c
11c
10a
10b
11a
11b
12c
9c
13c
12a
12b
13a
13b
14b
14a
15a
15b
17
9a
16b
9b
16a

EXPLANATION OF PLATE -3

18. Rosalina floridana (Cushman) x 54
18a, dorsal view, 18b, ventral view, 18c, apertumal view.

19. Globratella sp. indet. X 44
19a, dorsal view, 19b, ventral view, 19c, apertural view.

20. Ammonia annectens (Parker and Jones) x 24
20a, dorsal view, 20b, ventral view, 20c, apertural view.

21. Ammonia beccarii var. tepida (Cushman) x 59
21a, dorsal view, 21b, ventral view, 21c, apertural view.

22. Ammonia sobrina (Shupack) x 52
22a, dorsal view, 22b, ventral view, 22c, apertural view.

23. Asterorotalia trispinosa (Thalmann) x 44
23a, dorsal view, 23bp ventral view.

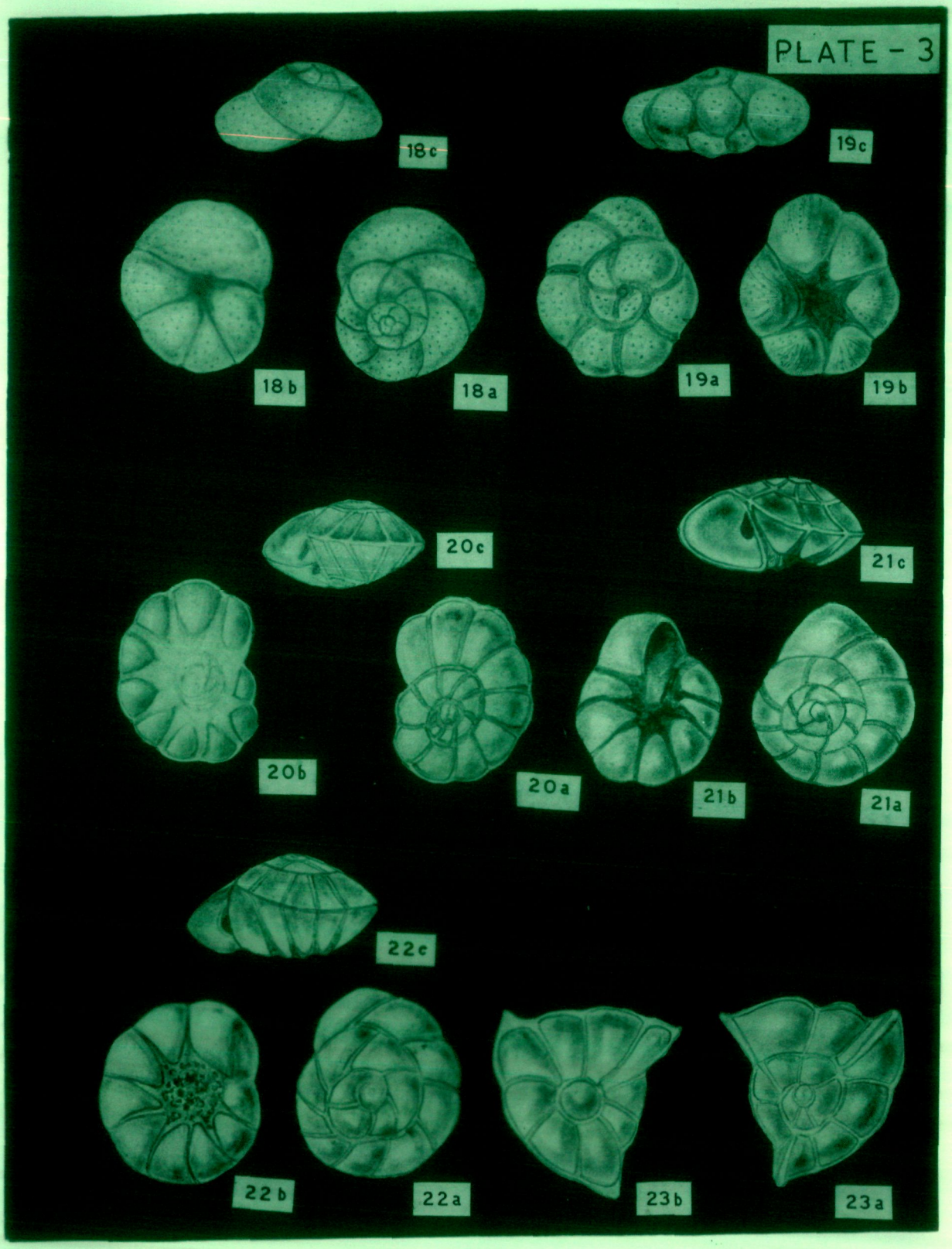
PLATE - 3
18c
19c
18b
18a
19a
19b
20c
21c
20b
20a
21b
21a
22c
22b
22a
23b
23a

EXPLANATION OF PLATE -4

24. Pararotalia nipponica (Asano) x 34
24a, dorsal view, 24b, ventral view, 24c, apertural view.

25. Pseudorotalia schroeteriana (Parker and Jones)x28

26. Elphidium advenum (Cushman) x 50
26a, side view 26b, apertural view.

27. Elphidium crispum (Linne) x 58
27a, side view, 27b, apertural view.

28. Eponides repandus (Fichtel and Moll) x50
28a, dorsal view, 28b, ventral view, 28c, apertural view.

29. Amphistegina radiatus (Fichtel and Moll)x40
29a, side view, 29b, apertural view.

30. Cymbaloporetta bradyi (Cushman) x 36
30a, dorsal view, 30b, ventral view, 30c, side view.

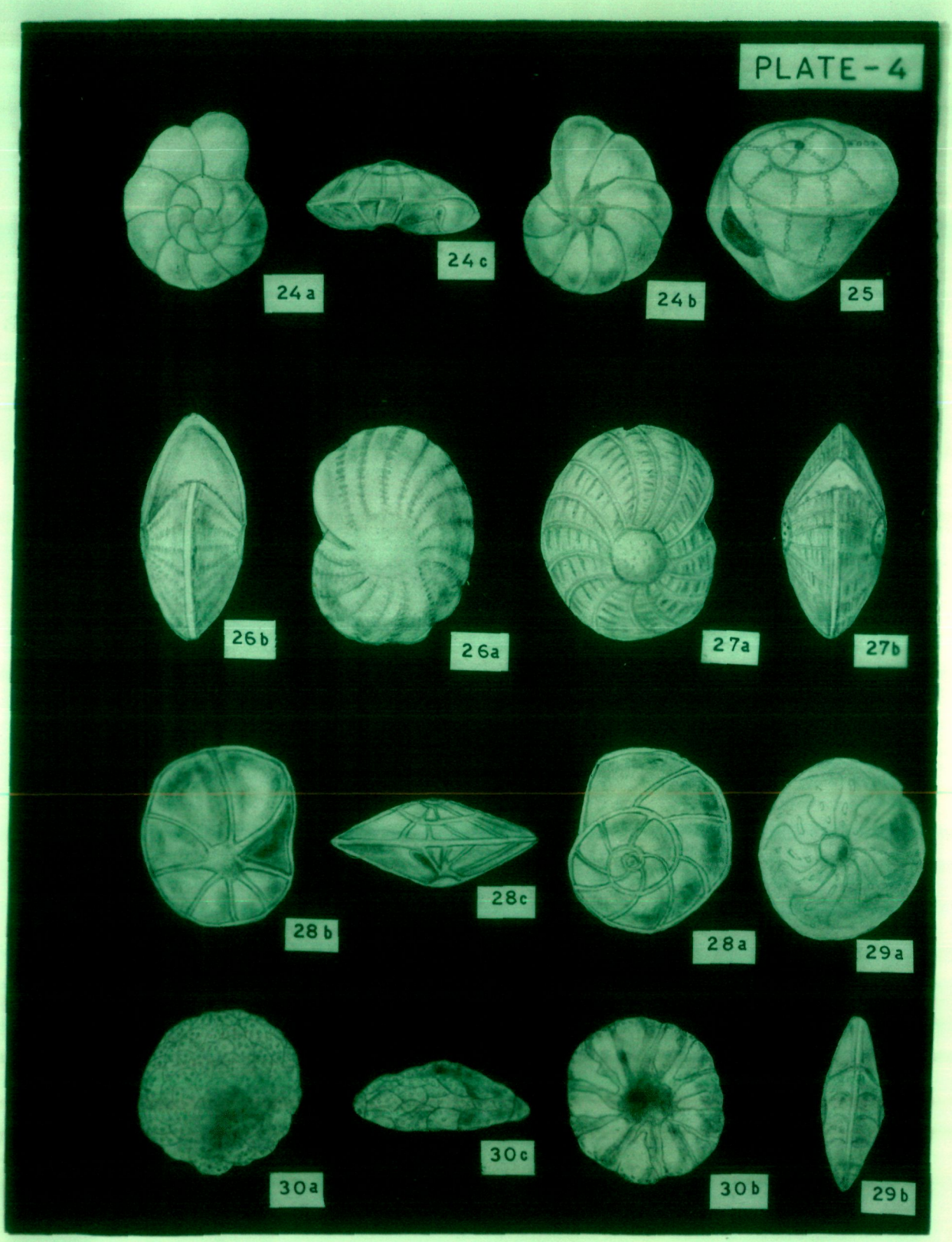
PLATE-4
24a
24c
24b
25
26b
26a
27a
27b
28b
28c
28a
29a
30a
30c
30b
29b